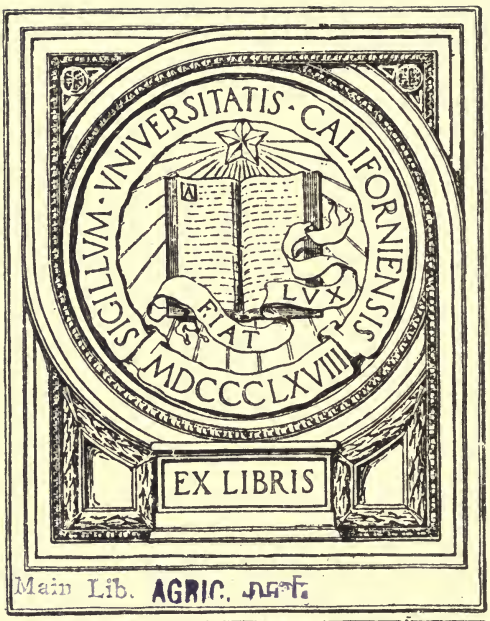

HOW · TO GROW · AND MARKET FRUIT

· PRICE 50 CENTS ·

How to Grow and Market Fruit

Practical Explanations and
Directions for Making
Fruit Trees Produce Profit

PUBLISHED BY

HARRISON'S NURSERIES

BERLIN, MARYLAND

WE FEEL that acknowledgment should be made to the following men for the help they have given in making "How to Grow and Market Fruit" complete and reliable. From their constructive criticism of the manuscript we have been able to get many valuable points. We thank them here, and the use and appreciation of the ideas they supplied will be permanent commendation of their knowledge of fruit growing and their courtesy.

On the spraying chapters, the help of Mr. G. R. Cushman, Baltimore, Md. (of Thomsen Chemical Company), has been invaluable; for their criticism on the book in general we are indebted to Prof. W. F. Massey, Salisbury, Md.; Prof. H. E. Van Deman, Washington, D. C.; Mr. W. H. Collingwood, of the "Rural New Yorker;" Prof. L. H. Bailey, Ithaca, N. Y.; Mr. J. H. Hale, South Glastonbury, Conn.; Mr. Gabriel Hiester, Harrisburg, Pa.; Mr. G. P. Miller, Romney, W. Va.; Mr. D. Gold Miller, Gerardstown, W. Va.; Mr. D. Maurice Wertz, Waynesboro, Pa.; Mr. E. J. Rook, Medina, N. Y.; Mr. Jacob R. Edmonds, Hagerstown, Md.; Messrs. Terpenning & Herring, Ulster Park, N. Y.; the Department of Entomology of Pennsylvania, Harrisburg, Pa.

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Example of good air-drainage. Exposure to south and east, yet orchard ideally located. Owned by W. J. Lewis & Bro., Pittston, Pa. (Photo by W. J. Peck.)

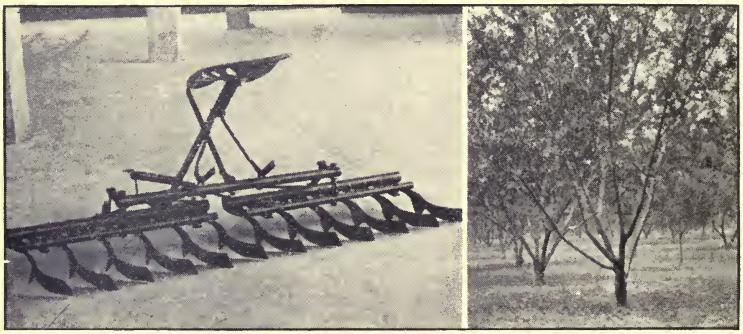
Pear trees and grape-vines along road. Any fruit trees or vines good for this. Practice utilizes otherwise waste space. Should be copied everywhere.

Cowpeas planted in rows for combined soil improvement and pea crop. Applicable to any farm. Young apple trees in Harrison's Nurseries.

Clean cultivation. Clean, whitewashed bark, low, open heads, in Hood River orchard.

Clean cultivated orchard in Delaware. Higher heads not so desirable as lower ones.

Splendid care of young trees, and effective Norway Spruce windbreak (Pennsylvania)



Young orchards should be cultivated clean. Acme harrow will do the work well.

Where help and time are scarce, plowing and leaving alternate strips is good practice.

Harrison's Service to Growers

YOU probably know that our nurseries comprise about two thousand acres in young fruit trees and strawberry plants, and that we own, or have interests in, bearing orchards of apples, peaches, pears, etc., which cover four thousand acres and contain two hundred thousand trees.

The orchards are scattered here and there over four states. Our bearing trees are on mountain land and low land, on all slopes, in all kinds of soil. Every kind of disease and every sort of "bug" by which fruit trees are affected has to be fought, and every known method of cultivation, fertilizing, protecting, pruning, picking, packing and selling can be found in use—at one time or another—in our orchards.

Starting as many young trees and plants as we do, planting and caring for as many orchard trees as we have, we get a practical working knowledge of how to grow fruit. We work out the thing from planting seeds to receiving the checks for the fruit. We know just what our fruit costs. What is said here is the most practical kind of hard-won knowledge.

To decide the merits of a cake, eat a piece of it. Our cake has been more than sampled. We have eaten a big piece of it—have even made a steady diet of it for thirty years. It is delicious and wholesome. This proves that our materials are right, our recipe good and our methods correct; *for we have succeeded in growing good trees, and in growing and selling choice fruit*—succeeded beyond what most men think is possible. Our young trees have come to be the standard for this country. Our orchards pay big.

Three or four years ago the thought came to us that our experiences ought to be interesting and valuable to a large number of growers and planters of fruit. So we started Harrison's Service Bureau, and invited our friends to ask questions. Soon, however, so many questions were asked that nearly all of our time was needed to answer them personally, and for this reason we designed the first edition of "How To Grow Fruit," published year before last. This book contained a digest of what we had to say about the common processes of fruit-growing—and letters answering most of the queries received.

Our success with "How To Grow Fruit," the story, has been as marked as in propagating fruit trees and in growing fruit. So we have decided to go a step further and give the public a book along the same lines. This book we call "How to Grow and Market Fruit," and it now is in your hands. It will anticipate most of your questions, we think, and it may tell you things you would like to know, but which you have not asked about, for it outlines "how we do it" in most of the processes and methods of fruit-culture. Should, however, a situation arise which is not provided for in the book, our stenographers are "on the job," and we urge you to write fully for a personal reply.

HARRISON'S NURSERIES
BERLIN, MARYLAND

The Fourteen Essentials

READ the entire book. Every chapter, and almost every paragraph, is related to every other chapter or paragraph, as each phase of fruit-growing is related to every other phase. The index will direct you to all the pages on which any subject is mentioned. Where a tree, orchard or plant is mentioned in the following pages, the discussion often embraces any or all kinds of fruit plantations.

Fourteen elements, or conditions, are necessary for growing all fruit. Each kind needs certain special treatment, yet if any of these fourteen elements or conditions are lacking, the result is failure, complete or partial; when all are present, and the few special attentions are properly given, tremendous crops are reasonably certain year after year—crops of highly colored, richly flavored, juicy, firm and flawless apples, peaches, pears, plums, cherries, quinces, grapes or small fruits.

The maker of wagons, watches, shoes or other articles must have machinery and tools, oil, fuel, power, a supply of raw material, and other essentials—a factory and an organization. An orchard is a factory; the product is the fruit. By having the essentials, we can make fruit. The greatest difference between a wagon factory and a fruit factory is this: We can make any style of wagon and use any method, but in producing fruit we must choose the size and characteristics desired from among a few dozen varieties, and secure the finished product by following nature's plans.

Growing fruit is easy, and almost any one can do it, yet it is more complicated than wagon-making or watch-making. The fruit-grower is forced to adopt or originate ideas and methods which fit the conditions; he cannot make the conditions fit the idea or blueprint. This requires study, observation, judgment, work, skill and perseverance. Without these the fruit-grower must fail; with them, he can make of fruit-growing something better than he could make of anything else in the world.

The fourteen requirements of a fruit factory are suitable soil, nitrogen, potash, phosphorus, lime, decaying vegetable matter and water, light and warmth in the right proportions, the absence of enemies, the right varieties, good trees, good marketing and *personally applied know-how* on the part of the grower.

Every process described here is intended to help the producer secure some of these vital elements with the least possible labor and cost. *That* is the fruit-grower's problem; his degree of success depends upon how he solves it, no matter what kind of fruit he grows or in what quantities.

Things Needed by All Fruits Alike

WHILE each kind of fruit requires special treatment, certain primary conditions are necessary for all. Methods which produce these conditions with apples, for instance, are equally good for the peach orchard or the strawberry patch. That which is right for one fruit, within these limits, is right for all.

Of these conditions, the first to be considered is the getting and keeping of plant food and of moisture, which requires three-fourths of all the effort expended in orchard culture. First, we shall consider the question of moisture—of both too much and too little water.

TOO MUCH WATER

A fruit tree will not yield if water stands about its roots—if it has "wet feet." There must be good drainage to lower the level of stagnant water in the ground. This is understood so generally that nearly every one avoids low or swampy lands, or underdrains them thoroughly before setting out trees. Because it provides quick natural drainage (ignoring the other reasons), sloping land is better than level land for orchards.

Good natural drainage is greatly to be desired, but seldom is found. Even where it is markedly good, the use of tiles will give results which warrant putting them in. Generally speaking, only the highest, steepest land should be left without drainage. Flat lands nearly always need underdraining, and sloping or rolling land often has a close, hard subsoil which keeps water standing near the surface, at the roots of the trees.

While land may be dry enough in ordinary seasons, in the wet season the extra amount and quality of fruit due to underdraining often will exceed in value the entire cost of installing the drainage. On hillsides, the underdrains frequently will prevent washing. In any land, the space around a seepage spot or spring may be the most fertile in the field, and the only way to make this available is by draining.

By giving each place the drainage it needs, you can make conditions uniform throughout the orchard, adapting the entire area to the same cultural methods. If some spots are hard and sour, while others are loose and dry, they must be given different fertilizers and cultivation.

No matter how rich in plant food a soil may be, too much water will render the food useless for trees. Wise folks may say the land is too sour or too cold, or needs this or that. No matter what the name of the trouble is, you cannot get fruit from land that is too wet. Here are some of the reasons:

Before plant food can be taken up by the roots, much of it has to be prepared by bacteria. The best known of these are the legume bacteria, without which the clovers, peas and

vetch will not thrive. Other bacteria are just as important. All are living organisms, the same as animals or plants, but in a lower form, and they must have food. They live on vegetable matter and some plant-food elements which will not dissolve in water. In digesting these foods the bacteria do not destroy them; they merely change them into forms in which the trees can use them, as hogs or steers transform their foods into forms that can be used by the trees. Since nearly all plant-food elements must go through this process before they are available to plants, the bacteria are vitally necessary. When these bacteria die, their bodies are consumed by the plants, thus leaving no plant food to go to waste.

Under proper conditions the soil is full of bacteria, each handful containing millions. The most successful fruit-grower is the man who puts the soil into a condition favorable to these friendly bacteria, and has the greatest number feeding his trees and plants. Too much water will destroy the friendly bacteria and prevent their coming and multiplying. Moreover, it will hasten the growth of myriads of bacteria that are injurious to plants.

A wet soil packs. It contains little air. It partakes of the nature of a stone or piece of wood, and no one expects trees to derive nourishment from these. Favorable conditions help fruit trees to thrive; unfavorable conditions not only cut off this help, but aid the enemies of the trees.

The subsoil in an orchard should be loosened at the start, and every few years afterward. This is discussed in detail later in this book. Drainage helps to keep the soil loose as low as the bottom of the ditch, and in dry seasons this loose soil retains more moisture than packed soil, because there are more open spaces to hold water.

Drainage improves the *texture* of the soil, and has the effect of making it more fertile. The food elements in mellow soil can be used by the trees, while, if the soil is caked, the roots cannot get the food that is there. With a good drainage system, surplus water will run away quickly after the frost is out of the ground in the spring, and the soil will be dry enough to work much earlier than land not underdrained. Make up your mind to drain at the start; the young trees need it, and the work can be done more easily then.

The material to use for drains depends upon circumstances. Study the lay and character of the land, secure prices on different materials from home and other sources, learn about freight rates and labor, and then select that which will be cheapest for the service which it gives.

In very loose soil, cement drains throughout the orchard have been known to pay. Where the fall is more than one foot in one hundred, stone, lumber or tile will be satisfactory. A buried stone wall will carry off the water where there is a decided fall; but, if the slope is less than one foot in one hundred, use nothing except tile.

The bottoms of drains should be at least two feet deep in heavy clay and three feet deep in sand. They should be as

deep as possible and still catch the heavy rains before they cause surface washing. Whether they should be put between every row of trees, between every two or three rows, or only in the low places, depends upon how much water must be carried away.

Water wants to run downhill. If the land is nearly flat, use a level to find an outlet. Usually you will be surprised about the fall. Try to get an outlet which has plenty of drop-way, but it is better to drain into an open ditch which requires care two or three times a year than not to drain at all. No point in the drain should be lower than the outlet, and the grade should be perfect—without ups and downs. A fall of from three to six inches in one hundred feet will give good service, but with so slight a drop you should use a surveyor's level in getting the bottom of the ditch right. Drive stakes every fifty or one hundred feet, having the tops flush with the ground, and measure the depth of the drain from these.

A six-inch main will carry off the water from a twelve-acre field. No main drains should be smaller than five inches. Laterals should be from two and one-half to three inches in diameter.

Examine the mouths of all drains a couple of times a year, to keep them free from obstructions. Put wire screening over the openings, to keep out animals, frogs and snakes.

It is well to plow a furrow, every fall, midway between rows of trees where there is no drain. This, with the tiles and ditches, will keep the orchard during the winter and early spring in better shape than an orchard where the snow and rain fall on the even surface.

TOO LITTLE WATER

Lack of water during May, June and July starves more trees, and is responsible for more poor fruit, than any other cause. This is due to the fact that growers do not realize how much water a tree requires, and do not know how to prevent the waste of what they have. Even trees near a hydrant or pump are allowed to suffer, while a few gallons of water daily would enable them to produce a heavy crop.

In the drier sections of the United States, trees often suffer least, because growers there know how to keep the little rain that they *do* get. In all the eastern and central states, the rainfall is always sufficient to produce a heavy crop of leaves and fruits. Most of this comes in the winter and early spring; the problem is to keep it. In the West, irrigation is necessary, but it will not pay in the East unless the water can be run on the land easily. Bulletin No. 116 of the United States Department of Agriculture discusses irrigation at length. If you want to put water on your land, get that bulletin.

A few growers of strawberries have used "artificial rain" profitably. This is best supplied with three-quarter inch iron pipes, pierced with needle holes every few inches, and laid on the surface of the ground; or, better, elevated out of the

way. With the pipe on supports, a fine rain will fall whenever the water is turned on.

Plants and trees require from three hundred to five hundred pounds of water for every pound of *dry* matter grown. But that does not tell what we want to know—how much water fruit trees need. The following statements are based on long and careful experiments made in America, England and Germany.

Trees use water in two ways—by putting it into fruit and leaves, and by evaporation through the leaves. A stream of water constantly flows up every growing tree and evaporates through the leaves.

Apples need about three times as much water as peaches, and other fruits come between the two. To grow one ton of *green* timothy requires more than one hundred and fifty tons of water. Apples and apple leaves are more juicy than timothy stalks. If we take one hundred barrels (250 bushels) of apples as the yield per acre, we have a little more than six tons of fruit. The leaves and new wood on an acre would weigh at least a ton, so seven tons is a fair average of the weight of the orchard product from one acre.

If apples use water at the same rate as timothy, the trees on one acre will require ten hundred and fifty tons of water, which would make a layer *more than nine inches* deep.

The average rainfall between March and August, in all fruit regions of this country which do not depend upon irrigation, varies from fifteen to twenty inches. That moisture which comes before March the frozen crust prevents from soaking into the soil; that coming after August is of no use to the crop. There is no way of determining how much evaporates from the soil or how much drains away; what is known is that nine inches *must* be kept for the use of trees, or the crop will suffer.

Most of the feeding roots of fruit trees or vines are in the first thirty-six inches of soil. Anchor roots go deeper, but gather moisture and food for their own use only. This thirty-six inches of soil must be loosened so it will contain at least a foot of water, for allowance must be made for evaporation throughout the summer. The first three feet must be even looser than this, as the soil must contain a certain quantity of *air* for the use of the roots. In other words, the first three feet must consist of one foot of water and less than two feet of earth. The exact number of inches does not matter; the principle is to have *enough* water, with drainage to take care of the surplus.

The soil must be fine and loose; fine, because the smaller the soil particles are, the more water will cling to them; loose down deep, because the particles unite when they are packed, squeezing the water out and preventing it from circulating. Roots will not grow into solid masses of earth when they can find their way into loose soil.

Still another, and most important, reason for providing plenty of moisture in the soil, is that moisture is necessary to make the plant food available. The amount of this food in

the soil does not indicate how much plant growth that soil will produce. Put pure nitrogen, potash and phosphorus on a stone, a board or a lump of dry dirt, and the heap will not produce anything, although it is exceedingly "rich and fertile." You can pile fertilizer upon your acres by the ton, but you must see that the soil is in a receptive condition before you can hope to have the plant foods do their work.

When the thirty-six inches of soil is made fine enough and loose enough to hold the foot of water, it is in pretty good shape to feed the roots. The water which surrounds every particle of soil dissolves the crude elements, finishing the work of the bacteria, and serves foods to the plants in digestible form. Feeding roots need not touch all the food; if the water can dissolve the food, it will bring it to the roots as it is needed. Without enough moisture the soil would be hard and unfriendly. Nothing is so important to the crop as water. Every pint lacking means the loss of fruit.

The right methods make it easy to keep all the water necessary; with wrong methods, or no method, it is impossible to have enough, unless rain falls every few days during the growing season, which seldom happens. Unlike other essentials, the keeping of the necessary moisture does not cost much, for this really is accomplished by work that should be done in any circumstances.

Ground that is hard on the surface and undisturbed below cannot hold two inches of water in the first three feet. This would be too little even for peaches. There is water more than three feet down, of course, and some of this is brought up by capillarity, but because of the compact earth there and the distance from the *feeding* roots, little from this source ever benefits the trees.

Capillarity is the attraction which some substances have for others. It causes a drop of water to cling to or run along the bottom edge of a slanting board, rather than fall straight down. It makes oil follow a wick up to a flame. Only when capillarity is working well in the soil can evaporation steal that vital nine inches of water from you.

The example of the lamp-wick shows another force—the attraction of dryer air and sunshine for soil moisture. These draw up water constantly, except for a few hours during nights when heavy dew covers the ground. Even then the soil continues to send moisture to the surface, if it had been doing that during the day, and the air must continue to absorb it, as is shown by the fact that a wet cloth laid on the ground during a damp evening will dry during the night.

METHODS OF KEEPING MOISTURE

Professor L. H. Bailey of the College of Agriculture of New York has explained this subject so plainly that any one can understand it. He says:

"How shall we save the water? By holding it in the earth. If the soil is very fine and yet compact, the capillary pores or

small open spaces between particles will hold enormous quantities of water. If, then, we break up these open spaces on the surface next the atmosphere, we shall prevent the water from passing off by evaporation.

"The whole subject of saving moisture, therefore, falls into two means. The catching and holding of it (or the making of a reservoir), and the prevention of evaporation. The first thing to do, therefore, is to plow or loosen up the soil and subsoil to a sufficient depth. When we have the water, we must then work the surface in such a way that we can keep it.

"It will thus be seen how useless it is to try to save the water by beginning tillage when a drought is threatened. If the land has not been prepared, there will be little water to save by that time. It will either have soaked away through the soil into drains, or it will have evaporated long before the need of it was noticed.

"The hardpan may be so near the surface that but little water will stay in the soil. The dish-pan formed by it is so shallow that the spring and early summer rains make mud puddles on the surface and pass off before the water is needed by the trees. Such soil needs to be plowed very deeply, and the subsoil broken up to increase the storage capacity for water.

"If the soil is sandy, soft and leachy, shallow breaking up is the thing needed. Such soil may be loosened too much. The water-storage capacity of soils may be increased by mixing humus or vegetable matter with them. It will thus be seen that the methods of conserving or saving moisture for the time when it is needed by the trees or plants must be thought out and worked out by each grower for his own place.

"Any body or substance which is interposed between the air and moist soil will prevent evaporation of the moisture. The ground is moist underneath a board, so is it underneath a layer of sawdust or of ashes; and so is it underneath a layer of two or three inches of fine, dry earth. Shallow cultivation will make a mulch of this kind on the surface. The orchardist should work the land as often as it begins to get hard and crusted—as a fit statement, it may be said that fruit lands ought to be worked every ten days, also after every rain, before a crust forms. Land allowed to lie bare over winter will weather rapidly, but clay-lands of a lighter nature will gully badly."

Land which lies rough-ploughed over winter will take up lots of water, but no more than it will if it is covered with crimson clover, peas, vetch, rye, or any other cover crop, and these crops have many other invaluable advantages. Cover crops save moisture. They must be put in during July; then, by the time the plants begin to draw water, the trees do not need it, in fact, should be checked. Then, if the crop is of a kind not killed by the winter, it will grow up very rank in the spring and help dry off the land early by absorbing water. It always must be plowed under early in spring—about as soon as the ground is fit to work—or it will rob the trees of water and food, and do much more damage than it does good.

Home fruit and flower garden worth twenty times its cost. Dwarf trees are most suitable.

Clover as soil improvement and cover crop. Note superior care given young trees.

Stone wall buried here, providing drainage. Orchard of W. J. Lewis & Bro., Pittston, Pa.

Harrison Ray peach orchard, August. Left: Cover crop. Right: Asparagus inter-crop.

Beans as inter- and cover-crop among apples. Gives soil improvement and cash returns.

Strawberries as inter-crop among apple trees. This orchard is irrigated.

Action of proper charge of dynamite correctly placed for subsoiling (and sometimes for digging tree holes). Ground heaved, not thrown out and scattered.

To put soil into shape to store water, subsoiling should be done thoroughly before trees are planted, and every couple of years afterward until they are ten years old. If it is done with a plow, the first subsoiling the year before trees are planted should cover the whole area; at the next, the year after the trees are planted, a four-foot strip should be left where trees are, and later the plowing should be narrower each time until the last time only one or two subsoil furrows should be plowed midway between tree rows. Subsoil plowing helps greatly to hold moisture, but there are other reasons for doing it. Subsoiling with dynamite is a thoroughly practical method, and should be employed on three-fourths of the farms of the East.

An underdrain midway between tree rows wonderfully helps the soil to store moisture by keeping the earth porous and fine. During the winter and spring the surplus water sinks into the earth to the level of the drain, where it falls, then finds its way horizontally to the drain. In doing this it opens and makes fine the soil it passes through, and the spaces remain filled with water until the roots draw it out.

Another moisture holder is humus. Decaying grass stalks always are damp, and they, too, loosen the soil. Earth which is full of them seldom becomes so dry as pure clay or sand. Pure loam is nothing more or less than humus. Mulches of all kinds plowed under will fill the soil with moisture-retaining material, and at the same time will make it more and more loamy. A heavy, stiff clay can be almost transformed in this way, because the moisture helps to disintegrate the cruder earth into loose loam. Humus helps to drain away the surplus water, and helps to *hold* that necessary nine inches.

By far the best way to loosen subsoil is with dynamite. This is not generally known, but orchardists will find they can reduce tillage expenses greatly and save much time with it. The exploding of from a sixth to a half pound of the right kind, two or three feet under the surface, loosens and makes fine all the soil. Young trees will make great strides if they are planted in dynamited holes.

The dynamiting can be done in orchards or about trees of *any age.* If done rightly, it will accomplish the work without breaking or tearing away any roots, leaving the soil in condition to give the roots twice the feeding-ground they had before and providing perfect drainage and water-storing capacity. The use of dynamite is the secret of success in growing fruit by mulching systems without so much plow and harrow tillage. This is the only way known by which soil can be loosened deeply after trees fill the space with roots, and often it is the cheapest and quickest way to loosen it at any time. Heavy clay lands are handled especially well by this method; in sand the advantages are least. With only plowing and drainage to rely on, one thorough subsoiling has to last during the life of the orchards. Good results can be depended upon for many years, but when signs point to the soil becoming too compact, dynamite will loosen it up as easily as at first, even though

the trees are large. See further information about dynamite on pages 34 and 37.

A mulch of some kind (dust, dead grass, weeds, etc.) is needed to insulate the moisture from the air. In all sections where the rainfall between March to August does not exceed from sixteen to eighteen inches, tillage and cover crops are best adapted to retain moisture. The land should be plowed in April or May, turning under the cover crop, then gone over immediately with a Cutaway, spring-tooth or Acme harrow, and then harrowed with spike-tooth every eight or ten days until in July. The new cover crop should be sown in July, partly to use the remaining moisture. The trees do not need water after that time. They should begin then to ripen wood and fruit.

Only two or three harrowings with the spring-tooth are needed. The teeth should go about three inches deep, and a leveler-drag should be attached to the harrow. For the remaining times use a spike-tooth harrow. A roller should be used but little, except on very light soil, and should be followed at once by a smoothing harrow. A day or so after every rain, harrow to break the crust, even if you had finished just before the rain. Never allow a baked crust to form, for it will quickly suck the water out of the soil beneath.

The whole idea, so far as moisture is concerned, is to keep a layer of dust-dry, powdered soil two to three inches deep on the surface all the time. As it is not handy to dig around each tree every time you harrow, and impossible to harrow with any satisfaction closer to a tree than a foot or eighteen inches, a heavy mulch of leaves, straw or dead grass should be placed around each tree. Young trees especially need this, since they have small root systems, and the soil right where they stand dries out quickly. This mulch is a great labor-saver, and does the work well.

In sections where the rainfall from March to August is as much as twenty inches, the sod mulch system is, without doubt, the best way of taking care of the moisture problem in an orchard. The essence of this system is to grow between the trees enough grass to nearly supply the trees with plant food when it decays. A little commercial fertilizer is added. No part of the grass is taken away. It is mowed two or three times a season and most of the cutting raked up and piled under the trees. Sometimes this mulch is eighteen inches deep under the trees and for a few feet outside in a circle, although over the rest of the ground an inch or two is all that should be left. The ground under it always is moist. Each season's growth is worked into the surface of the soil by frost and water (or by a cutaway harrow) thus providing another moisture holder. It is in connection with a complete sod mulch system that dynamite is most valuable, in ways any grower can see, for the ground never is plowed or torn up.

At least six inches of water are needed to grow this heavy crop of grass, hence no less than eighteen inches of rain will be enough for a mulch sod system. If the grass contains much

clover, more water will be needed. Care must be used in dry sections and seasons to mow the grass sufficiently early in spring, and to keep it mowed more or less close to prevent it drawing too much water from the soil. It must be remembered that the necessary eighteen inches or more of rainfall must come between the spring breakup and August 1, and not in a whole year. This method certainly takes less work than cultivation. It should be considered by every one where conditions warrant its use. Thorough underdrainage should accompany it.

SUMMARY

Trees must not have wet feet. The level of stagnant water in soil must be, at the very least, two or three feet down, if trees are to bear worth while.

Too much water destroys friendly bacteria that are necessary to put plant foods into forms in which trees can use them.

Too much water renders plant food useless by changing it chemically and by caking soil.

Carefully laid underdrains are almost an orchard necessity, and do good in many ways.

Breaking up hardpan helps drainage. Cover crops help to dry off land in early spring.

Apple trees must have at least enough water to make a layer a foot deep, and this must be held in the top thirty-six inches of soil. Other fruits can get along with slightly less, but must have enough.

Too little water starves trees directly by allowing them to dry up, and to even a greater extent by making it impossible for roots to get the food in the soil. Plant foods and fertilizers are of no use unless they continually are accompanied by enough moisture to dissolve them and insure that they soak to the roots.

There is always enough rainfall between March and August to grow big crops, *if it is rightly conserved.* Right methods make this easy, wrong methods make it impossible.

To store enough water, ground must be broken up deeply, thoroughly and often; and to avoid its escape the surface must be worked and kept in a dust mulch, to prevent evaporation during the growing season, if other mulch is not used. This conservation tillage must begin early in spring, while ground is still damp, and must be done every ten days or after every rain till in July or August.

Organic matter in the soil helps to hold moisture.

With sod-mulch systems, the grass must be mowed often to prevent its using up the moisture intended to be saved.

Feeding Fruit Trees

PROFESSOR BAILEY has put so many of the facts of this subject into clear and lucid words that he deserves to be quoted freely. In stating the situation he says this:

"Any land which is fit for the growing of crops will maintain a fruit plantation throughout its existence without the addition of plant-food, and enable the trees to produce at the same time a normal quantity of fruit. But the profit in fruit-growing lies in securing the extra quantity and superior quality, and this result demands fertilizing of the land and every other good care. The extra quality and extra quantity seem to depend a great deal on the fertility *we supply*."

When we remove fifteen or more bushels of fruit from a tree every year, we are going beyond "normal quantities," and additional plant-food will be required because of this. Nitrogen, phosphorus and potash are the principal foods on which fruit trees live. A few other minerals, almost always present, enter into their diet, but in quantities so small that they may be overlooked. The soil is the table at which they eat, while water and tillage, sunlight and air, are the cooks. Each food must be supplied in the right quantity, in the right proportion with others, and in the right way, if the trees are to thrive.

Food elements must be given in the right condition, as partly explained in the talk on moisture, or trees cannot consume them. Hay, raw meat, or raw and unground grain contain all the *elements* needed for men, but men would not thrive on them. It is just as important to "grind and cook" the nitrogen, potash and phosphorus for trees as it is to grind and cook meat and wheat for yourself. We cannot make fruit out of plant-food elements until they are refined.

Now, to grind and cook and refine plant-food elements, we must have them dissolved in water. Carry them in soil that is just as fine as it can be made, and that contains no acids which work harmful results. We get them dissolved by saving enough moisture for use at the right time. To have them distributed well through *fine* soil, tillage or other subduing methods must be employed.

At the beginning of the earth, all soil was rock. Gradually this was worn down, until moss and plants got a foothold, grew and died, mixing their dead leaves and stalks with the coarse soil year after year until now there is much fine, silky loam. The hardest soils are the same as the best, except that the lumpy or sticky ones have not had as much treatment from water, air and sun as the better kinds. This explains why the kind of soil never is very important so long as proper care is taken.

Bailey explains soil processes in this way: "Nature is a kindly and solicitous mother. She knows that the elements must be unlocked and worked over and digested by the roots of plants. Plant tissues add fiber and richness to the land,

Left: Newly-set strawberry field, across rows. Right: Ground prepared for asparagus.

Tomatoes as inter-crop in combined apple and peach orchard. Splendid inter-crop.

Sod-mulch system in apple orchard. Left: Grass mowed and left under trees.

Sod-mulch—wet season, grass left grow high. Seven-year trees of W. J. Lewis & Bro.

Orchard back next woods yields $2,000 net per year. Bad location considering insects.

Three-year trees of W. J. Lewis & Bro. Note apples on tree (Stayman Winesap)

Left: Five-year tree in Harrison orchard, bearing 388 apples. Right: Clean cultivation.

How to handle sod-mulch system with young trees. Note mulch is pulled back from trunk.

and make it amenable to all the revivifying influences of sun and rain and air and warmth. The plant is copartner with the weather in the building of the primal soils. The lichen spreads its thin substance over the rock, sending its fibers into the crevices and filling the chinks, as they enlarge, with the decay of its own structure; and finally the rock is fit for the moss or fern or creeping vine, each newcomer leaving its impress by which some later newcomer may profit. Finally the rock is disintegrated and pulverized, and is ready to be still further subdued by corn and ragweed, by other plants, or trees."

Thus it becomes plain that to feed our trees we first must work our ground—tear it up deeply and thoroughly pulverize it. We must fill it full of dead grass and leaves in order to change its texture—to change that old rock nature to loam nature. This must be done to give roots a chance to take up any food the soil *carries*. The soil itself never is food for plants.

This is where all processes work together. To conserve moisture, we work the land. To drain, we work the land. To do both of these, we use dynamite and heavy mulches. When we save or get rid of water, we grind and mix the soil, which is exactly the treatment the soil needs to improve its texture. So far, so good; but often, to get enough fineness and mixing, the treatment has to be continued after it could be stopped so far as moisture is concerned.

LIME ACTION

We should like to say here, "The decay of vegetable and animal matter produces some acids." That statement would be clear to most people, but it is not correct. There is no such thing as *decay* of these organic materials. Wherever a piece of meat, a stalk of grass or a leaf is touched by moisture in or on the ground, millions of bacteria attack it. They swarm to it from every surrounding particle of earth, and feed upon it until seemingly it disappears. In reality it does not disappear, but is changed into other forms by the bacteria, helped to a slight extent by the chemical action of minerals. The work of bacteria is like that of the buzzards, which gather from everywhere and consume a dead body.

Organic matter is added to the soil in the form of manures, leaves, rotting fruit, plowed-down cover crops, grass and weeds, mulches, bone phosphate, etc. In consuming these, bacteria produce acids. These acids change plant-food from available into insoluble forms, kill the bacteria which produced them and which are needed, and in other ways hinder or prevent plant growth.

Organic matter is necessary, yet we must get rid of the acids. Lime is the thing to do it with. The action of lime is called sweetening. The work lime does is to deaden the acids by taking away their "edge," making them incapable of doing harm. Wet soils generally are especially acid.

The wood of fruit trees contains lime, in a form almost

pure. Leaves and fruit have only a trace, but fruit will grow and mature in a shorter time, and therefore ripen earlier, or rather more completely and uniformly, when trees have plenty of lime than it will when they do not. The fruit also is likely to have a higher color. For these reasons, lime can be said to have a small food value. It can hardly be classed with the *foods*, however, and its chief value comes indirectly.

Lime should be worked into the surface of the ground—never plowed under. Harrow or disk it in. It should be put on evenly, with a lime spreader or drill whenever possible. On sod, even distribution over surface is all that is needed. It may go on at any time in the year, but better avoid the months from July until November, as then it might, by releasing insoluble plant food, result in forcing fall growth of trees—a bad thing always. From 500 to 1,000 pounds to the acre, 16 to 35 bushels, will produce a good effect on light land. Generally it is profitable to use a ton or more, say 50 to 80 bushels, on an acre of heavy land. The amount to use depends on the kind of soil. The amount of humus in the soil largely determines the amount of lime to use. Light land will be burned by using more than 20 to 25 bushels. With heavy clover or other sod to act upon, you can use lime more liberally.

Pulverized lime usually is the best form in which to buy and use lime. Lump lime, air-slaked in piles, or new-process lime, which is lump lime slaked by steam, are good also, although only 90 per cent as efficient, and twice as heavy and twice as bulky. A pound of ground *limestone* will do half the work of a pound of lime. In using ground limestone, there is more than double the weight to handle. The best form in which to buy depends on three things—the cost to you, the freight to your field, and the efficiency, or "strength," of what you get.

Every orchardist must learn the supreme importance of serving food to his trees on a table properly laid. Trees are particular. By continued study of actual conditions, and by accumulating outside information, every one can learn what to do to put his soil into the right shape.

SUPPLYING PLANT FOOD

In feeding trees, the first things to consider, after putting the soil into the best shape possible, are the needs of your particular orchard. No two pieces of land are alike. Wide differences often will be found within a hundred yards, and these varying conditions call for the food elements in varying proportions.

When trees have dark leaves, bright-colored bark, and grow a foot or more of new wood each year, they are getting about enough nitrogen, and all you have to do is to keep the supply at the present rate. It is possible to provide too much nitrogen, especially in bearing orchards. Trees are suffering from a lack of nitrogen when the leaves are light-colored and when they ripen and fall early in autumn, when the bark is dull

and dark, and when the new wood each season is less than a foot long.

Lack of potash and of lime is shown by sappy growth, by many suckers, and by pale, tasteless, unripe fruit. Fruit trees use less of phosphorus than of the other food elements—probably only one-fifth of the number of pounds and of the value of it, as of nitrogen, and one-sixth, as of potash. Phosphorus goes into fruit, leaves and wood. Potash is the most important of the elements. Potash and phosphorus are mineral materials, and have to be supplied in chemical form. Nitrogen is supplied best by legumes—by the cover crops.

Cover crops should be called "fertility crops," for, while they are useful in preventing washing and leaching, cementing and baking, and in the holding of moisture, their greatest value lies in their power to add directly to the richness of the soil. Some of the plants adapted to the purpose supply nitrogen, and all supply organic matter—supply these materials cheaper than they can be had from any other source. The aim in sowing a cover crop is to plant it long enough before killing frost to enable it to make a good, thick growth in the fall. If the plant is one that winter-kills, this makes little difference; but, if it grows again in the spring, more vegetable matter will be had before time to plow it down.

The stalks, leaves and roots add several tons of organic matter to the soil. This is placed right where it will do the most good—in the upper foot of soil,—whether the crop is plowed under or disked in. It does its work, as has been explained before, by improving the texture of the earth, by holding moisture, by making a home for bacteria, and by returning to the soil the plant-foods which it gathered through its roots, together with new nitrogen gathered by the leaves.

All the legumes gather nitrogen from the air, and store it in every fiber of the plant. One good clover, pea or vetch crop will give your acre as much of this high-priced plant-food as you will get in $20 worth of any commercial fertilizer. Legumes use potash and phosphorus, of course, but they do not waste it if they are left on the land—they return it whence it came. This is true of all cover-crop plants. The foods which they consume are only loaned to them over winter. In the spring all the materials come back for the use of the trees, with added nitrogen in the case of legumes, and with protection and physical soil improvement from all kinds of cover plants.

A cover crop is sown in the latter part of the summer, when trees have made their growth for the year, and when both fruit and trees have begun to ripen. Newly sown plants take up water in great amounts—take it away from the trees. This is the thing desired at this time, for tree growth needs a check then. But, still better, young plants require a great deal of nitrogen, but comparatively less potash and phosphorus. As the cover crop grows, it feeds largely on the nitrogen, less on the other elements, leaving much potash and phosphorus for the trees, *just when they need them most.*

It is potash and phosphorus which put color in fruit, which give it the rich flavor, and which harden the wood of trees so they can stand zero weather. We build the framework and size of our apples or peaches or grapes with nitrogen, but we put the high quality in them with the two other foods, and to a slight extent with lime. In this, when analyzed, lies the explanation of why a sod-mulched tree will put a higher color on its fruit than a cultivated one; also why a cultivated tree generally is the larger. Sod-mulched orchards generally, comparatively speaking, lack nitrogen, and have plenty of potash and phosphorus, while in cultivated orchards this condition is likely to be reversed, or has that tendency unless corrected.

In our judgment, the orcharding system best to use is the one that will combine the good points of these two methods, giving trees or plants the growing material—nitrogen—in the greatest proportions before July, and the ripening and quality producing materials—potash and phosphorus—later.

While cover crops absorb plant-food in the fall, they are doing another good act. The food they use generally is in available form; that is, ready dissolved, in solution. If it were to be left in this shape over winter, much of it would leach away; but, when the cover plants use it, they lock it up until spring, and so prevent its waste.

These are the principal reasons why cover crops are so valuable in orcharding. Each man must study his own situation, decide what his trees need, and plan the best and cheapest way to get these materials. The best sources of the needed plant-foods will be found now in one form of the elements, again in another. Even one kind of cover crop will not do, year after year, so well as rotation of them.

Again Bailey has stated a point so clearly that we can not do better than quote him: "The choice of the proper crop for the covering of an orchard is a local matter, the same as the determination of the method of tillage or the kind of fertilizer is. There is no one cover crop which is best for all purposes and all conditions. The grower must study the condition of his trees and his land, and then judge as best he may what course he shall pursue.

"Nature's cover crops, at least upon farms, are weeds, and these may be useful if allowed to grow in the fall after the tillage is completed. The difficulty is that they cannot always be relied upon to cover the land at the time when they are wanted, most of them do not live through the winter, and they are very likely to become a serious nuisance. It is therefore best to substitute some other plant for the weeds.

"In the question of the choice of cover crops, the grower must remember that there are two great classes in respect to their power to gather nitrogen. The one class is non-leguminous, comprising those plants which take only such nitrogen as has already been worked over into available form by plants and animals; the other class is the leguminous plants, comprising those which have the power of appropriating and utilizing free nitrogen.

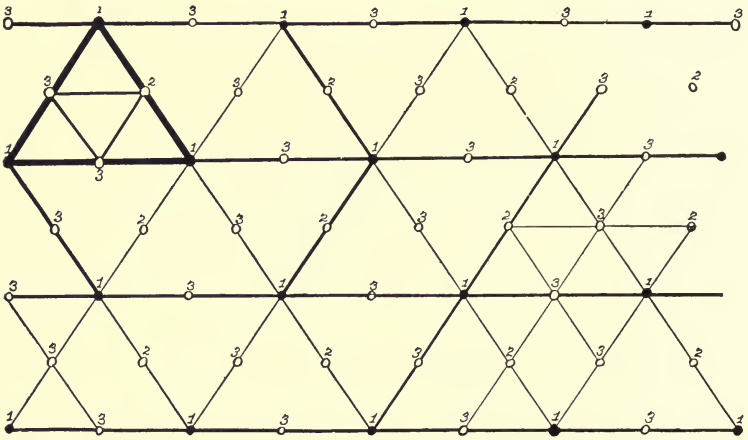
Strawberries as paying inter-crop Appie trees two years old, bearing a few apples.

Tomato crop raised in this young orchard will be worth $60 an acre net each year.

Plank drag that does great work in conserving moisture. Useful for many crops.

Clean cultivation, proper heading of trees and good orchard arrangement of trees.

Left: Five-year tree planted in ordinary dug hole. Right: Five-year tree not fifty yards away, planted in dynamited hole. Pole eight feet high.



Diagonal planting plan, with fillers. No. 1 trees, permanent; No. 2 trees, to be removed when 10 to 12 years old; No. 3 trees, to be removed when 18 or 20 years old.

In South, heel-in like this, but in North cover tops and all with dirt—use no straw, or mice will nest there and chew trees.

"For purposes of cover and protection, the non-leguminous crops may be just as good as the nitrogen gatherers, and when the fruit trees or plants are growing very vigorously they may be decidedly better than the others, because, by not adding nitrogen, they do not over-stimulate the growth. A rotation of cover crops will nearly always be found to be important. It is perfectly possible to put so much nitrogen into the land that the trees or plants grow too vigorously or too late in the season."

Some of the most useful of these cover crops will not thrive on hard and intractable land, and in such cases a rougher and coarser crop must be used. Bailey says further that "the golden scale of cover crops for orchards begins with rye and ends with crimson clover." In saying this he, no doubt, had in mind the condition of most lands—which are hard, intractable, lacking in humus and poverty-stricken in many ways at first, then becoming more mellow, richer and better drained, as orcharding processes are worked out, until finally the soil is in good condition.

Rye, it will be seen, is preëminently the cover crop for rough, unsubdued land, while crimson clover is at its best in fine, mellow, fertile soil. Buckwheat and Indian corn can be used instead of rye, but they are harder to plow down. The corn should be sown broadcast. Turnips and rape also will make a complete cover on hard land. All of these crops should be sown in July or August, or about six weeks before a killing frost, and all of them will cover the ground completely before they are frozen down.

But these crops are makeshifts. When we use them, it is because the finer, true cover-crop plants will not do well, for some reason connected with the land which we wish to protect and improve. The idea is to build up the soil by the use of these coarser plants to the point where the better ones will do their best work. None of these coarse crops should be used continuously, year after year.

The legumes, comprising all the clovers, vetch, cowpeas, Canada peas, and common field beans, are the cover plants which gather nitrogen, and at the same time give the protection and the organic matter supplied by the others. Common field beans, Canada peas and cowpeas can be sown on coarser lands than the clovers because their seeds are larger and a catch is surer. Peas and clover mixed form a good combination. Clover with rye and the other non-legumes also is good. Where clover and peas are used together, the peas will be killed by frost, leaving the clover in possession.

If legumes are sown six to eight weeks before killing frost, the plants will grow thickly and cover the ground in fine shape. Plenty of seed should be used, especially of cowpeas, of which the Black and Whip-poor-will varieties are the best for the North. All varieties do well in the South. Canada peas will stand much cold, and will grow later into the fall than cowpeas. All peas except Canada are hot-weather plants and will make a rank growth even in dry weather.

Vetch should be sown from July 1 to Sept. 1. It is pretty sure to catch, is a legume, like peas and clover, and sown then it will be knee-high and very thick in the fall. Heavy frost does not kill it, and it will start again in the spring. This mat plows down easily in the spring, even though it will have made a good growth by April.

Mammoth, common red and alsike clover never reach their best until they have occupied the land for more than a year. It is true that they will make a fairly good growth by winter if they are sown near the first of July, but, unless conditions indicate that the orchard needs a rest for a year, other cover-crop plants will be found to do the same work better.

Crimson clover, on the other hand, is an annual. It completes its natural growth in a year from the time of sowing, and is not killed by the winter. When it is sown in July a good growth will be made before winter sets in, and again in the spring before time to plow, which will be as soon as the land is dry enough. This gives more organic matter with which to loosen up the soil, and gives a longer period from which the plant can gather nitrogen from the air.

Crimson clover is the best clover plant we have for sections south of the line of Trenton, N. J. The only limitations to its use are those of its habits. It will not always catch in poor or rough land, nor is its catching at all sure more than four out of seven times north of the line named. Usually a certain amount of soil-fertility building has to be done before it will succeed. If you find that crimson clover will thrive and make a thick cover on your land, you do not need to experiment with other crops, as you have the best there is. Crimson clover should be sown from July 15 to August 15 in the Middle Atlantic states, earlier north, later south. In Pennsylvania and north, peas or some other cover-crop plant should be sown with it.

The following figures show the approximate quantities of seed which are recommended per acre for cover crops in young orchards. Old orchards will need less:

Barley	2 to 2½ bus.	Cowpeas	2 bus.
Beans	1½ to 2 bus.	Millet	1 to 1½ bus.
Buckwheat	1 bu.	Oats	2½ to 3 bus.
Canada Peas	1 to 2 bus.	Peas	2 to 3 bus.
Clover, crimson	8 to 16 lbs.	Rye	1½ to 2½ bus.
Clover, red	6 to 12 lbs.	Turnip	3 to 4 lbs.
Corn	2½ to 3 bus.	Vetch	1 bus.

Common sense will direct how these crops be put in. Sow the coarser seed as you would wheat or oats, the finer as you do clover or timothy. Use a machine or drill, if possible, as that way gets the seed on more evenly. One thing, however, cover-crop seed should always be worked in with harrow if sown broadcast. Peas are sometimes sown in rows, especially where the "grain" is wanted, but this takes more work.

The following statements of the amount of plant food needed by fruit trees are based on data given by Professor Bailey. These figures give a clear idea of the quantity of food used by

a tree. The average is taken from the trees on one acre, planted thirty-five feet apart, and over a period of twenty years between the thirteenth and thirty-third years of their age.

An average crop of *apples* from one tree removes, in round numbers, eleven pounds of nitrogen, one pound of phosphoric acid, and sixteen pounds of potash. The leaves with this crop will contain ten pounds of nitrogen, three pounds of phosphoric acid and ten pounds of potash. No figures are given for the amount used in making new wood. The total for fruit and leaves is twenty-one pounds of nitrogen, four pounds of phosphoric acid and twenty-six pounds of potash.

For an acre of trees, the amounts would be something like 1,887 pounds of nitrogen, 310 pounds of phosphoric acid and 1,895 pounds of potash. The total value of these plant foods taken from an acre in twenty years is about $379. To restore the potash alone would require about twenty-one tons of wood ashes containing five per cent of potash. To restore the nitrogen would require more than sixteen tons of a fertilizer containing five per cent of nitrogen, or more than five tons of nitrate of soda containing fifteen per cent of nitrogen.

Another calculation by the same investigator shows the amount of plant-food which you may expect the fruit and the leaves to carry away *in ten crops*. The data follows:

	Apples	Leaves	Total	Value
Nitrogen	498 lbs.	456 lbs.	854 lbs.	$143 30
Phosphoric Acid	38 lbs.	126 lbs.	164 lbs.	11 50
Potash	728 lbs.	441 lbs.	1,169 lbs.	52 63
Total value				$207 43

"One of the best sources of potash for orchards is wood ashes," Prof. Bailey continues, "but this material is so often weakened by leaching that it cannot be confidently recommended. A good sample of unleached hardwood ashes should contain from five to nine per cent potash, but some of the commercial article does not analyze above two or three per cent. Potash in this form has a trade value of four-and-a-half cents per pound. To this value of potash in wood ashes should also be added that of two per cent or less of phosphoric acid, now worth six cents a pound,—but only if your land needs phosphoric acid. If it does not need that element, you cannot afford to buy it. Forty to fifty bushels to the acre is considered to be a good dressing of wood ashes, if it has been kept dry.

"Muriate of potash is perhaps the best and most reliable form in which to secure potash at the present time for fruits. Commercial samples generally contain from 80 to 85 per cent of muriate of potash, or about 50 per cent of actual potash. Kainit is an impure muriate of potash, containing about 12 to 15 per cent potash.

"Sulfate of potash is also thought to be a good form in which to buy potash. The commercial article analyzes 50 per cent or less of actual potash. Slyvinit is a lower grade of potassium fertilizer. Its value, like that of other materials mentioned, should be reckoned upon the amount of potash present.

"Phosphoric acid may be obtained in the form of a high-grade plain superphosphate (like dissolved South Carolina rock) in bone compounds, and in Thomas slag. The plain superphosphate contains about 15 to 18 per cent of phosphoric acid. Two hundred to five hundred pounds per acre is a liberal and very useful dressing for bearing orchards. The bone fertilizers are always valuable. Those which are untreated give up their phosphoric acid slowly, unless they are very finely ground. Dissolved bone gives more immediate results."

Thomas phosphate or basic slag is especially valuable, because, in addition to its 15 per cent or more phosphoric acid content, it contains about 40 per cent of lime. Some report that it parts with its fertility very slowly, but this depends upon how finely it is pulverized, and on the kind of soil to which it is applied. If there is much acid in the soil, or slight saltiness, this basic slag phosphoric acid will dissolve quickly and completely. It is especially good on marshy, loamy lands. It is sold at a price which, considering the large amount of plant-food elements it carries, gives cheap phosphoric acid.

Again from Professor Bailey: "Muriate of potash costs $40 and upward per ton, sulfate about $48, dissolved bone-black about $25, ground bone about $30, kainit about $13, and nitrate of soda 2½ cents per pound. These prices vary, of course, with the composition or mechanical condition of the materials.

"The average composition of unleached ashes in the market is about as follows: Potash, 5.25 per cent; phosphoric acid, 1.70 per cent; lime, 34 per cent; magnesia, 3.40 per cent. The average composition of kainit is 13.54 per cent potash, 1.15 per cent lime. The composition of sylvinit (which is known as sulfate of potash in some quarters) is about 16 per cent of potash, in the form of both muriate and sulfate, mostly the former."

The best chemical source from which to get nitrogen is nitrate of soda, which contains 9 to 15 per cent available nitrogen, or 180 to 300 pounds of available nitrogen in a ton. If legumes are used as they ought to be, little nitrogen need be supplied from any other source, and the nitrogen secured from plants will cost about one-fifth of what it will otherwise.

When starting to fertilize an orchard, it is often well to use a combination of potash and acid phosphate, with a cover crop, and watch the trees carefully during the growing season. If they show a light color, a small amount of nitrate of soda can be used.

Suppose your soil has been fed a balanced ration, and now is in good producing condition. If you want to feed trees in such a soil, a fertilizer containing one and a half to two per cent of nitrogen, two or three per cent of available phosphoric acid and 10 to 12 per cent of potash, will give excellent results when applied in quantities ranging from 400 to 600 pounds to the acre. This means a complete, ready-mixed fertilizer. The different elements can be purchased and applied separately if that would be cheaper.

As a guide to the application of the proper materials separately, we would say that the following proportions are about right for a balanced tree diet: 100 pounds of nitrate of soda; 100 pounds of South Carolina rock; 200 pounds of ground bone; 200 pounds of muriate of potash. The amount to be used depends upon how much the trees need; for instance, large old apple trees would require more than young apple trees; peaches would require more than strawberries; run-down orchards would need more than those well fed.

Apples in full bearing, and on loose soil, may receive as high as 1,000 pounds of muriate of potash to the acre. A normal application, however, would be from 150 to 300 pounds. In the best orchards, growers believe that large applications of all the elements, of course in the right proportions, will pay more proportionately than the smaller ones. Generally there is a limit to both the smallest and the largest quantities that are profitable to apply, but don't use fertilizer blindly. You will waste it if you do. Give the trees the elements they lack. See that they have as much of each kind as they need. More will do no good; less will reduce growth and production. Good treatment all along the line is what brings good results.

To get the chemical fertilizer *on* the ground evenly is vitally important. A drill is the thing to use if you do not want to do it by hand. For the first few years at least it usually is best to apply to each tree, by hand, the exact quantity which you decide is needed. *This should be scattered over a space twice as wide as the branches cover.* The old idea that roots go only as far as limbs has been proven wrong time and again. Roots will cover three times that diameter. If limbs are eight feet long, you can depend on finding roots twenty or more feet in every direction.

Barnyard manure seldom is good for bearing trees. It contains too much nitrogen and causes sappy, out-of-season growth; it likewise has too many weed seeds for comfort. It does good work, however, around young trees, where it can be used as a mulch. These need nitrogen with which to build a frame of wood quickly. If it is used, apply it early in the spring, as soon as the winter surplus of water has run off, and then sow a cover crop early in July to take up excess nitrogen.

It is impossible to lay down rules for the best handling of all orchards. Each piece of land must be studied separately. After a bit one will know what is needed, and can base his work on experience and observation. Keep your eye on the individual trees. The first year give them what *you think* they ought to have. If they respond, you have hit upon the right thing. Bear in mind, though, that three-fourths of the results of feeding trees appear in the second and third years after the food materials are supplied.

Experiment with different combinations and amounts of fertilizer. You can in this way learn what is best. Each tree is an individual. Feed it according to its needs. After a number of years of intelligent treatment, all trees in an orchard can be brought into uniform condition, so the whole orchard

may be treated in the same way, simplifying the work. Generally it is best to apply each food separately. Mixing is not needed; unless you can buy complete fertilizer that is made exactly as you want, mixing will not pay.

When the sod-mulch system is in use, careful watching of trees and fruit to see what food is needed is doubly necessary. Potash generally has to be supplied most liberally in chemical (or commercial) form. The source of food on which the main dependence is placed, with this system, is the dead grass that is mowed and left on the land. How much of each food this contains it is impossible to tell except from the behavior of trees. What this grass does not supply must be given in another form.

Whatever plan is followed regularly, it sometimes pays to change for a year or two. A cultivated crop such as potatoes or tomatoes is good, and besides, will pay well. Then a sod-mulched orchard may need a stimulant. Plow it up and cultivate for a season. Turn down a good heavy crop of a legume. This, together with the regular sod turned under, will change the soil conditions and generally will arouse the trees.

Double crops are those grown between trees *for a harvest.* They may or may not add fertility to the soil—usually they consume great quantities of plant food which must be replaced from outside sources. Yet they pay well when handled right. Tomatoes, strawberries, potatoes, asparagus, beans and melons are the ones usually the best to grow.

From the fertilizing point of view, which is half of all that is to be considered in the use of double crops and orchard filler, the thing hinges on just this: Don't try to take more out of your soil than you put in, and put back into the soil as much as or more than you take out. Outside of these limits, the more crops the better. In growing crops between trees, watch the trees. Remember you are growing the trees, not the secondary crop. Keep the trees growing fast, and healthy in every way. Supply food and moisture for *everything that grows on the land.*

Double crops undoubtedly complicate the situation a great deal, as the orchardist must study the needs of his other crops in the same way as he studies the needs of his trees. Bear in mind that the profit is the amount *between* the value of the crop and the cost of the extra labor and of the plant-food you have to supply. Do not rob the trees. Burn that on a large sign, stick the sign in your orchard where you can see it all the time; then go ahead and raise inter-crops until the trees begin to bear nicely.

SUMMARY

Crops that pay big profits are unnaturally heavy crops, and to get them *we must feed the trees.*

Soil itself never is food for trees—it merely carries plant food—and it must be finely and deeply pulverized, loosened, and filled with decaying vegetable matter before roots can absorb the plant food present.

"Decay" is mostly the action of bacteria.

Lime is not a plant food to any extent, but is badly needed by trees, to help them use plant food and to help put the soil in good physical shape.

Make your soil fine and loose and loamy before you add fertilizer and you will not need to add so much.

No two pieces of land are alike in plant-food needs. Learn to know what elements are lacking, and supply them in right proportions. Do not waste fertilizer by blind applications.

Potash, nitrogen and phosphoric acid are the plant foods that have to be supplied. Nitrogen usually is best gotten through leguminous cover crops. Potash and phosphorus have to be supplied in chemical form.

Nitrogen is the growing material, making wood, and size in fruit; potash goes into fruit largely, making flavor and color; phosphoric acid goes into wood and seeds, but only a fifth as much of it is used as of potash.

Cover crops disintegrate and pulverize soil, add to it organic matter, prevent plant food from leaching and (the legumes) add nitrogen. The kind to use depends on your locality and your soil.

Get plant foods on the ground evenly, over a space at least twice as wide as the branches cover, and apply it at the right season.

Double crops pay, but you must supply plant food and moisture for *everything that grows on the land.* Do not rob the trees.

Cultivation, Mulching and Other Orchard Treatment

WHY should we use time and money in "fooling with the dirt" around trees? Before we came to this world there was fruit which grew without a bit of care. Why not adopt *those* methods now?

The answer is simple: We do not cultivate to kill weeds, nor mulch to keep frost out. We do this work to increase the number of bushels or boxes or baskets or carloads of fruit; to better its size, texture, keeping qualities, its color and its taste, and to make the trees more vigorous. We are not satisfied with either the kind of apples our grandfathers grew, or the quantity they produced.

To obtain these results, it is necessary to save moisture, to promote drainage, to change insoluble plant-food elements into available plant food, to improve the texture of the earth (make it fine, and thus give roots a better chance to feed, mix it with dead vegetable matter, and so subdue it more and more), to increase the depth of useful soil, to make the temperature of the soil average higher and have less range, to prevent

winter damage to trees, to keep plant-food from leaching away, to prevent gullying and surface washing, to produce conditions under which the soil will dry off and either warm up sooner, or stay cold longer, as desired, in the spring, to supply plant-food, to help friendly bacteria grow and increase, and to destroy unfriendly bacteria, insects, fungi, weeds and animals.

Anything that will help accomplish these things is good, but the best methods are those which do it with the least trouble and expense in proportion to each dollar's worth of fruit grown. No one procedure is best all the time. Each different process will secure partly some of the objects; usually it will be found that the program can be varied to advantage. What to do depends upon the trees, weather, soil, location, pocket-book, facilities, the time at command, and the purpose for which the fruit is wanted.

All methods are related but do not overlap. With a certain purpose in view, you often can start with one method, and carry on or finish the work better and at less expense by a different process. The most successful fruit-growers do not have any one set system for their work. They recognize that all orchard processes have their uses, and that there is little choice of what to do in any situation, when things are understood and the *best* way is wanted.

Mulching with grass grown in the orchard, mulching with straw and other materials brought into the orchard, growing and turning down cover crops, cultivating with plows, harrows, dynamite and underdrains, are the means we have of giving culture to orchard land.

Before trees are planted, the ground should be subdued thoroughly. "Subdued" is exactly the word to use. The treatment should be whatever is needed to accomplish that result. Usually it is best to first grow one or two cultivated crops on the land. This will show the wet spots, the hard ones, the places where subsoil comes close to the surface, and acquaint you with every corner. You then can drain or do anything else needed without interfering with the trees and without having the trees interfere with the work.

In the discussion of drainage, moisture, and feeding trees, we explain the essence of orchard culture. As we have said, it is necessary to break up the subsoil, whether there is hardpan or not. Subsoil plowing will do this in preparing the land at first while the trees are young. Underdrainage will help constantly to loosen the soil, and to keep it loose. The dynamite method usually is the cheapest at any time, and it is the only way by which the work can be done thoroughly after the trees have been in three or four years.

How much dynamite to use, what kind, how deep and how far apart the holes should be, are details which are decided by simple experiments in the kind of soil to be loosened. Dynamite manufacturers will supply all the information needed. They have issued several practical handbooks for distribution. Test out your soil by trying three or four pairs of holes 30, 36 and 42 inches deep, charged with third, half and whole

Left: Good planting plan for peach orchard. Right: Properly headed peach tree.

West Virginia Orchard with excellent air-drainage. This orchard worth $1,200 an acre.

Apple trees planted 20 x 20 feet. At eleven years old they are too close.

Fill chicken yards with plum and cherry trees. Trees will thrive.

Eighteen hundred apples were thinned from this tree in June—increasing yield.

Left: Dwarf pear tree trained to wall. Right: Dwarf apple trees trained in flat form.

Old pear trees that have yielded $25 worth of fruit a season for years.

sticks. Shoot and examine carefully. The ground should not blow out, but should be loosened six or eight feet on each side of the charge.

Dynamite is the thing with which to dig holes for new trees, to break up the whole soil three or four feet deep every few years, and to help renovate old orchards, because it will do these things more cheaply and better than they can be done by any other means. If you have fruit trees which seem to be standing still and which do not bear, no matter how big they are, properly explode a charge in the soil around or between them, and the trees will likely get to work. In a bearing orchard, a proper charge midway between trees is always safe and is generally very effective.

In soil work with dynamite, the *proper* charge will *heave* the ground over a space from six to twelve feet in diameter, and as a by-product kill all insects and grubs. Under certain instances tree holes should have the dirt blown out, but it is generally best to merely loosen it up. A big shovel will sink down to where the tree should go at one motion if the ground has been heaved. Ditching in heavy, wet land can be done sometimes to advantage with dynamite. In this work heavier charges are placed close enough together to blow out the dirt.

After you have torn up the soil, harrow and roll it repeatedly. Make the upper six or eight inches as fine as garden soil. This will take time and work, but will save both in the next five years. If orchard land is cared for properly in its early stages, no heavy plowing will be needed later. There should be plenty of vegetable matter in the soil when the trees are planted. It is not necessary to turn furrows in plowing orchard land. Cutaway or disc harrows are better than landside plows. *Mix* the soil—that's the thing. Stir it up. After you have the work started, any kind of harrow, cultivator or drag will do good work.

After plowing, be sure to get the air-spaces between furrows entirely filled. Air is needed in the soil, but never in larger quantity than a "chunk" the size of a pin-head at one place. Each cubic inch of soil should have several hundreds of these. Use rollers, clod-crushers, or soil-packers after plowing, until you are certain there are no big air-spaces a few inches under the surface.

How cultivation feeds trees and saves moisture has been explained already, but here are more details. Young orchards of any kind *always* should be cultivated clean, from spring until in July. Plow or tear up the soil as soon as ground is dry enough to work, harrow after every rain, and every week or ten days until it is time to sow the cover crop, or to mulch for winter.

Keep young trees hustling. They have to build a big frame on which to carry their crops, and they have only a few years to build it in. Make them grow all they can every year, just so they stop in time to ripen their wood before frost. Young trees can keep on growing with safety a month or six weeks

longer than bearing trees. The cultivation keeps them supplied with available plant-food and with sufficient moisture. Start cultivation of apples before the buds even swell in spring. See that trees are hoed around. A half-penny's worth of work will do wonders for your young trees. This early cultivation is most important and we always think that it is worth more than twice the work done a month later.

As for the depth to work, go deep while you can. The first or second working each spring should reach a foot below the surface in all the space *not* occupied by roots. Later harrowings need go only three inches deep, and two inches will do. Where roots are, and close up under the trees, four inches in as deep as the ground should be worked. But remember this working so often directly under the branches of a tree is of far less value, either in conserving moisture or in feeding that tree, than working the space from the ends of the branches out to the next tree, because three-fourths of the *feeding* roots are beyond the branch tips.

Never cut off a valuable limb to get under it with team and tools. Better by all means depend on harrows lapping over there. Bearing orchards should be worked the first time in spring six or eight inches deep, if they have been used to that depth all their lives. If they have been in sod, tear up only four inches of soil, because many roots will be even higher than that. One of the values of cultivation lies in making the roots go deeper, keeping them away from the dry, hot and cold surface, and down where they can feed all the time.

Some of the pictures here show bearing trees which have no space at all under the limbs. There are great advantanges in this system when it comes to spraying and picking. But cultivation under such trees is impossible, and the way to handle them is to cover the ground under the limbs six to eighteen inches deep with hay or straw every year. When trees are first planted, this mulching for three or four feet around each is the best thing that can be done.

Care must be taken to move the mulch back about a foot from the tree before every winter to guard against damage by mice, and in no case should the mulch be closer than six inches to the trunk, summer or winter. The ground should be heaped up slightly about the trees, too. Mice will not cross this open space. This mulch will save the moisture under it; the trees can be fed just the same, and in many ways it is better to mulch under the limbs and cultivate up to the mulch than to try to work all the surface. In southern Ohio can be seen a practice of gathering weeds and trash of all sorts and hauling it into the orchard around the trees. Rome Beauty, York Imperial, and other similar apples respond wonderfully to this treatment.

The sod-mulch system of orcharding is this same idea carried further. The whole surface of the ground is covered with a stiff, thrifty sod of blue grass, timothy, red top and clover, or with almost any permanent grass that will make hay. A legume helps in supplying nitrogen. Then this is kept mowed

down as often as it seems worth while, beginning in the spring as soon as the weather gets dry. Some orchardists who use this system mow as often as the machine will catch the grass, as with a lawn, and leave the grass where it falls. Others mow less frequently, allowing the grass to get a foot or so high each time. Sometimes two mowings a season are enough; again, four will be needed. Cut in this way, the grass will not use so much water, and will provide a continual shade that to a certain extent has the same effect as a mulch of dust.

No matter how often mowing is done, half or two-thirds of the green hay ought to be raked up and spread under the trees and over a few feet beyond branch tips. The vital point in the success of sod-mulch orcharding is: Not a blade of grass is to be removed from the orchard. If there is too much to go under the trees, say more than enough to make a mulch eighteen inches deep, the surplus may be left over the center spaces, the layer getting thinner toward the middle. Some of the largest and highest-colored apples and pears and plums seen in the markets or shows come from sod-mulched orchards. Peaches and dwarf pears almost invariably *fail* in sod mulch. They *must* be cultivated.

The sod-mulch system will produce wonderful results on apples and pears in the hands of growers who will do it right, where there is enough rainfall. Sod-mulched trees usually do not make as much growth as those which are cultivated. For this reason all young trees should be cultivated. Often bearing trees are big enough, anyhow, and on them extra growth simply means extra pruning and heading back to keep them low enough.

A net return of $38 more from a cultivated apple orchard than from a sod-mulched orchard adjoining it was noted in a thorough test in New York, where the conditions were identical; yet this proves nothing more than that in this case the sod was not a good thing. In this experiment, the apples from cultivated trees were not colored so well as those from trees in sod; but they averaged larger, had a better flavor, and kept better late in winter.

Rocky soils sometimes are fine for fruit, but they cannot be worked at all except with dynamite. On such places get a good sod, mow it regularly at the right time, mulch the trees with the hay, add some potash, and your orchard will be a great success with little work. Steep places can be treated in the same way; but terracing, or tearing up and leaving alternate strips of sod every year, working half the ground each season, often will produce bigger crops and still prevent washing.

Do not pasture your orchard. Bearing trees will pay you more than $250 to the acre if you allow them to, but they will not if they are mistreated. Be satisfied with that return and do not try to get another crop. Remember that the droppings of animals will *not* return a tenth of what the animals *take from* the soil. The same rule applies to the usually double crop between trees. The yield of wool, mutton, beef, pork,

hay, grain, etc., from an acre of orchard could not possibly be worth more than a fraction of the value of a full fruit crop; yet to raise any of these in the orchard will reduce the value of the fruit crop to only one-fifth or even less of what it would have been without them. Never think of *removing* a non-cultivated crop from between rows of fruit trees.

Apples, pears, cherries, and plums, in *light sandy soil*, especially where rainfall in the growing season sometimes is short, always are best clean-cultivated. Peaches and dwarf pears, in any soil, always should be cultivated well. To facilitate this, larger growing trees may be headed high enough at the trunk so that limbs will clear the team, and the limbs of smaller trees will not project far enough to interfere. Keep harrows and plows away from trunks of trees. Turn plows out when near trees on all sides. Finish this space with a hand hoe if it needs to be cultivated. Use center-trace harness whenever possible; this is made by putting the doubletree across the collars in front, and hitching by one chain or rope from the center of the doubletree directly to the plow or harrow.

Cover all the surface in harrowing, except that little space around tree trunks. Harrow in every direction if you can. In all cultivation try to keep the surface even and level. Allow no dead furrows or ridges. Even on hillsides, where there is a furrow next to the sod strip, harrow or drag this shut soon.

In case severe economy is necessary, or where help is scarce, a combination of the clean cultivation and the mulch methods can be used. Plow a narrow strip alongside each row of trees. Cultivate this and cover the rest with sod, and mow. A man by the name of Hitchings, in New York, uses this method entirely, in preference to any other treatment he could give his orchard, and he is certainly very successful.

Up to the time trees are six or seven years old, their roots will not occupy all the space, and cultivated double crops can be used. Even when filler trees are planted as close as fifteen or twenty feet, the ground between can be made to yield a profit while the trees are small; and at the same time, if proper fertilizers are supplied, the orchards will be benefited by cultivation given to these double crops.

Some of the best business farmers of the country say it costs entirely too much to bring an orchard into bearing without between-tree crops. When a man wants to start an orchard and does not have the money, he often can do it by growing four or five crops of strawberries, tomatoes, asparagus, or something similar between his trees. Do not plant potatoes, or any crop requiring digging after August 1, as this will act the same as late cultivation and force fall growth of trees. The May and June cultivation given these crops is just the thing required by young trees. Markets are waiting for these products. All that is required is to study how to pack them, and make proper arrangements for selling them. We advise sowing a cover crop with any intercrop, at the last cultivation, and let it come on. Rye or rye and vetch are good, and will make a cover crop to carry through fall and winter.

Pear trees too thick. Cut three-fourths of head off alternate trees each year.

How to head young peach trees. Cut branches back to stubs, and stem off to 12 inches.

Low, open-headed apple tree when young, and also when loaded with fruit.

Apple trees are splendid on lawn—left. Dwarf tree in commercial orchard—right.

How NOT to prune. Wrong season, stubs left, low limbs cut off,—tree butchery.

Five-year trees that are bearing from 100 to 250 apples each—three times too many.

Cultivation, like every other good thing, is good in its place, and bad when out of its place. All fruit trees should—and will, if conditions are normal—cease growth about July 1. Later growth will prevent fruit from ripening, and will send the tree into winter with sappy wood and buds. Now, when trees have not ripened as they should, buds and twigs are hurt by freezing to an extent seldom appreciated. We cannot always see this damage. Few realize that it ever is done. But a crop often is frozen one or two years ahead, and when we do not get fruit we say that something is wrong, yet fail to learn what that something is.

Cultivation must stop not later than August 1 in young orchards, and three or four weeks earlier in bearing orchards. A cover crop that will use up moisture and nitrogen should be sown, to make sure that ripening begins. There are other reasons for cover crops; but, from the cultural standpoint, this is most important. Allowing the ground to bake might accomplish the ripening, too, but it would produce bad effects as well. To aid ripening, mulches sometimes may be pulled back from trees in August. This applies particularly to young trees.

When to cultivate, when to mulch, and when to use sod, depends entirely upon the conditions. Each will produce its own effects. The grower must decide what methods are best—must decide what he wants to do with his trees, then use the means that produce that result. Consider every effect of what you are going to do. For instance, sod will ripen wood and fruit weeks earlier than cultivation, in the same way that a too-early cover crop will, by using up the moisture and nitrogen. Again, cultivation will destroy mice and insects; and still again, with mulch, fire always must be guarded against, particularly near railroads, woods and houses. Fire almost surely would kill the trees. There are dozens of points to consider. Study all, and use the methods best suited to your conditions, but modify them or change them entirely if this will produce better results.

SUMMARY

We do not cultivate to kill weeds nor mulch to keep frost out. We do these things to save moisture; to promote drainage; to change insoluble plant-food elements into available plant food; to improve the texture of the earth; to mix dead vegetable matter in the soil; to increase the depth of useful soil; to make the temperature of the soil average higher and have less range; to prevent winter damage to trees; to keep plant food from leaching away; to produce conditions under which soil will warm up sooner or stay colder longer, as desired, in the spring; to supply plant food; to help friendly bacteria grow and increase; to destroy unfriendly bacteria, insects, fungi and animals.

Mulching with straw and hay, growing and turning down cover crops and cultivating with plows, harrows, dynamite, and underdraining are the means we have of giving culture to orchard land.

Before trees are planted, the soil should be *"subdued"* thoroughly.

Dynamite tree holes, also break up hard pan and subsoil with dynamite, whenever possible.

Mix the soil—that's the thing. Stir it up.

Get rid of all large air-spaces a few inches down.

Begin cultivation of young trees as early in spring as possible. A penny's worth of work done in March or April is worth a nickel's worth in June.

Cover ground for a few feet about young trees with a heavy mulch. Leave a six- to twelve-inch space about the trunks (and heap up soil slightly) as a guard against mice.

Keep young trees hustling till time to bear, then make them yield without growing much excess wood.

Always cease cultivation in time to allow trees to ripen wood thoroughly before frost.

When done right, the sod-mulch system is good where there is plenty of rainfall.

No farmer will think of raising an orchard without growing between-tree crops that will pay from the start.

Study your trees and give them the treatment that they ought to have for best results. That is what orchard culture means, no matter what the methods used to effect the desired purposes.

Jack Frost

TO give this old gentleman the credit due him, it must be admitted that his children—cool and cold weather— put quality into fruit. Northern sections and higher elevations produce better fruit than southern sections and low regions; and those parts of the world where the nights are cool and days not too hot are famous for the quality of their fruit.

Take advantage of this fact whenever it is possible. If there is a choice, put your trees on high land for this reason, although there are others. Certain varieties thrive down low, but within the latitude adapted to any one kind the higher it is grown the better it will taste and keep. Take the York Imperial Apple, for instance. Grown below an altitude of three hundred feet in Pennsylvania, it is large, bright red, handsome, pithy, tasteless, and dry; grown at eight hundred feet, it is small, red-and-yellow striped, crisp, juicy, rich and "just fine." The same applies to variations North and South.

In this connection, we should pause and consider elevation. Of course, the higher we get, the less *total* amount of heat there is in a season. High lands usually have cooler nights than low lands, and the warm part of the day generally is shorter. The elevation at which the total of heat in a season falls below the requirements for growing and ripening a fruit cannot be given in definite figures that apply to all sections, because, as we go south, that line goes higher.

About every mile further south makes as much difference in the *season temperature* as about eight feet of elevation. That is, a point a mile south of you will have to be eight feet higher than your position to have exactly the same conditions; a point a hundred miles south will have to be eight hundred feet higher. The rule is that every degree of latitude equals five hundred feet of elevation.

Frost causes an immense amount of damage when not guarded against, however, by freezing blossoms, by freezing fruit before it is fully colored in the fall, by freezing buds, and by stunting and killing trees. A great deal of this damage is preventable by taking advantage of certain natural agencies, or by artificial means. It is not necessary to lose every second or third crop from frost. Even tender fruits, like peaches, can be made to yield every year by applying modern knowledge of preventing frost damage. The degree of cold which hurts fruit at various stages of growth has been learned pretty definitely. It is *not* always 32 degrees, the water-freezing point.

Of course, some kinds of fruit trees, buds and blossoms are damaged more easily than others. Dormant peach buds will stand ten or fifteen degrees below zero, some varieties more, others less. When peach buds have swollen the least bit, zero usually will kill them; when showing pink they can stand fifteen degrees above zero; when newly opened twenty-six degrees is the limit. When petals are falling, twenty-eight degrees will damage them slightly, and when petals are off they cannot stand much below thirty degrees. After that, thirty-two is the danger point.

Apple twigs, and buds, if ripened right, will stand almost any cold. Sixty below zero has been known to kill some varieties, but little fear need be felt for any apple tree—*when it goes into winter in right shape.* We have explained this subject in the chapter on cultivation. Apple blossoms showing pink will stand twenty degrees above; full open, twenty-six degrees; with falling petals, twenty-eight or thirty degrees. Pears are about the same as apples. Cherries and plums are slightly more tender; they might need two degrees more warmth, —but sometimes their blossoms come through black frosts with no apparent harm. Grape buds seldom will stand temperature colder than thirty-one degrees.

A point to remember is that blossoms may not show any frosting, yet still may be damaged enough to prevent their setting *perfect* fruit. Gnarly, crooked, small and bitter fruit is not always the result of insufficient pollination or damage by insects or fungi. It may have been caused by frosts in spring or winter.

The chief means we can make use of to prevent any and all of this frost damage are these: Locate within a few miles of a considerable body of water; locate on a slope, a bench or a hill-top from which *air can drain away* into lower land; avoid table-lands, plains, and, above all, pockets or valley floors; choose land facing the north or east rather than that facing south or west; cultivate so that trees will be late in starting to

grow and bloom in the spring, and early to ripen wood and fruit in the fall; plan or make use of windbreaks of other kinds of trees, and use smoke and moisture for protection when frost comes at critical times.

The problem of location already is solved for the great majority of growers and would-be growers. If you own a farm, that is the place on which to grow your fruit. The fact that you have it and know the soil gives you a greater advantage than you can secure by changing, unless you now are in a poor location for fruit, and can get a good price for your land. If this is the case, move into a section that is known to be good for fruit and as near the big markets as you can get. If you cannot change, you can make yourself practically safe from frost by wise planning and a little work.

Water heats up and grows cold *more slowly* than earth. When the sun beats down warmly during winter and early spring days, water stays cold, while land gets warm. Later, water gets warm too, but, unlike the land, it *stays* warm, and does not cool off every frosty night. And air always is of about the same temperature as the substance it rests on.

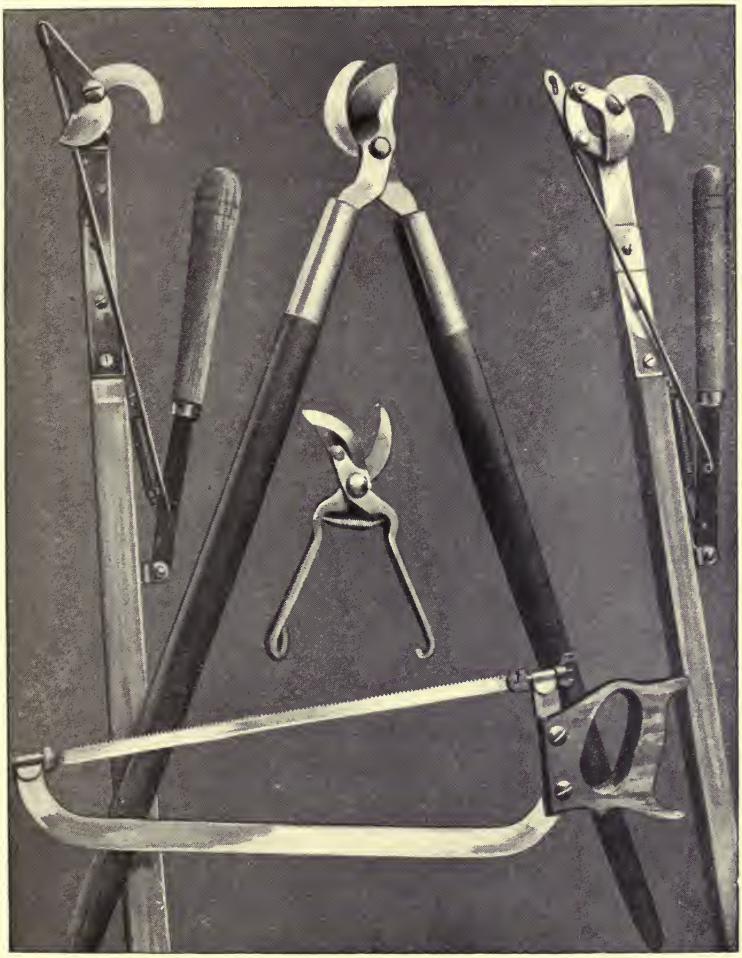
Now, both freezing of blossoms and "sun scald" (which is only freezing of sappy growth) would be unknown if there were no higher temperature to start growth, followed by low temperature that freezes it. To connect protection from frost with bodies of water, therefore, we have only to remember that warm air rises over cold air whenever it has a chance. During warm days in winter and spring, cold air from over water flows up into the vacant space left over land by warm air rising. This prevents trees from starting growth as soon as they would otherwise.

Then later, when spring has come in earnest and the leaves and blossoms are out, water and land both get warm in the daytime but along comes a frost at night and cools off both the land and its air. This cold air flows down to the water, to take the place of the warmer air which rises from the water and flows back over the land—and over the tender blossoms.

That, however, is not quite the whole science of water-protection from frost. The worst frosts come when the air is dry. If there is much fog, or vapor, or moisture, in the air, freezing will be slight or entirely absent. An example of this is seen in the fact that zero on the Atlantic coast, where the atmosphere is moist, actually is felt more—seems colder, and *is* colder—than twenty degrees below in Manitoba or Colorado, where the air is much drier.

Any *water air* will be damper than *land air*, so frost will not freeze so hard nor so quickly near bodies of water as the same degree of cold will freeze farther inland. If moisture is present in the air, from a shower, from ponds, ditches, spraying, or watering, it will act to prevent freezing. In irrigated sections, a large amount of protection from frost can be had by turning on the water, and so filling the air with moisture. Where there are only a few plants or trees, or a garden, a thorough sprinkling or wetting is the best possible protection

Left: Spreading peach trees require a little higher head than others. Right: A zinc tag on tree, on which is complete record of that tree's history.



Good pruning tools. Note wide open hand shears, and pole pruner—both double action.

Entirely too thick. 31 peaches here, and 15 are enough Should be 4 inches apart.

Evergreen windbreak at a sod-mulched orchard, proper distance between break and trees

Thinning pears and apples, also nipping tips of pear tree. June.

against frost, and this often is a most practicable method. One quart of water evaporated into the air, in a space eighty feet square will protect against frost as much as raising the temperature ten degrees.

A slope which faces the water usually is better than one exposed the other way. The prevailing strong winds, however, have something to do with this, as well as sun and soil. South and west slopes are not so good as others, except for quinces and grapes, so far as the frost problem is concerned. A body of water will influence the temperature to a useful extent up to a distance of from five to fifteen miles. No difficulty will be had in getting local information on this point, and one season's acquaintance with conditions will tell the story pretty well.

As the entire country from Ontario south is adapted to some or all of the fruits, there are ten times as many inland acres as there are of those under the protection of bodies of water. Over all this area other things must be relied on to control frost trouble. The first of these is *air drainage*—next to right varieties, moisture, fertility and pruning, the most important requisite for success with fruit.

The greatest danger to blossoms from frost comes during still nights. Frosts seldom come when a wind blows, because, when it is in motion, all the air is mixed together and its temperature is uniform throughout. After there has been enough spring warmth to *produce* bloom, nearly always enough will be stored up in that neighborhood to keep the temperature of *all the atmosphere* above the danger point if it is distributed properly by air movement or wind. Air-drainage is air-movement by gravity when the wind is *not* blowing.

Air-drainage, and freezing at blossom-time, depend on *comparative* height, *not* on distance above sea-level. It does not take much slope or drop to do the work, although several hundred feet will do no harm. Often a rise of ten feet will mark the line between frost and safety, and places with a difference of ten feet in elevation sometimes will show a difference of ten degrees in temperature.

Warm air rises, just as steam does. Cold air sinks, just as water runs down hill. Every little obstruction, like a few feet of roll in the surface, a hedge or windbreak, even the dirt thrown out of a ditch, will cause a deflection in the downward flow of cold air, and may protect or doom the plants in an area alongside of it. The shoulder of a hill, a hollow or a valley will direct air-currents.

When it strikes an obstruction in its flow, air bounds quite a distance away from the earth, and does not come down again for rods. The flow of air to the sides is deflected in the same manner. We can only hint here at the influences of various combinations of hills, bluffs, draws, woods, drops and land-angles. No rules can be given for this. By studying the situation you nearly always can tell where the flows of cold air will be. When the sun goes down, the earth and air cool rapidly. If it is a still night, the natural or gravity movement of the

air will send the frosty atmosphere down, down, down, to lower levels, by any open paths it can find.

Of course the exposed top of a mountain is likely to be affected by any frost in the air on still nights, but here, if anywhere, there is likely to be a breeze to drive the frost away. The sides of a hill, whether benched or sloping, usually will be free from frost when the bottom below is hoary. Low flats or pockets of land are frost traps, as they catch and hold the cold air that drains from the land above. If a valley is long, with an even fall and few obstructions, there may be a good flow of air along its floor. This will prevent frost. In such places the very finest lands for fruits are found, because of their advantages in soil, good roads, level land, etc.

Air drainage of any piece of land always is much more important than its exposure. Conditions on a northern or eastern slope will delay blossoming-time a few days; but if there is no lower-lying land into which the frosty air of spring nights can drain, blossoms will freeze every year or two. For this reason, certain tracts of land otherwise valuable are nearly worthless for fruit; and to plant an orchard on them invites failure, or at least an immense amount of work in fighting frost every year. You would better protect your trees against the frost for all time when you plant them.

Get definite information about frost, if possible. During blooming-time in the spring before you plant trees, put thermometers a few feet from the ground, on stakes, one down in the lowest pocket on your place, another a little higher up, and still others at every twenty or thirty feet rise all the way up the slope. By watching these thermometers carefully every hour or two during a couple of nights when frost threatens, you will get all the information needed, and know the strips of land to avoid because of frost. Where such a test cannot be made, carefully observe the lay of the land before planting any trees.

The relation of windbreaks to frost damage is mixed. Many times they prevent freezing, but they sometimes are the direct cause of it. For this purpose we can class a strip of woods as a windbreak. The flow of air-currents must be studied to understand the situation. When cold air flows from higher land on a still night, and strikes a *thick* windbreak, it rises over the tree tops and flows on to the middle of the orchard before coming down among the fruit trees. This will cause a strip several rods wide in the lee of the break to become badly frozen, because here there will be a dead-air space. The break forms a pocket of still air which is exactly like the frost trap formed by the hills in the bottom down below.

If the break had been thinner, really "breaking" the force of the wind, and not altogether stopping its motion, there would have been no frost alongside of it, while the decided benefit of deflecting the cold air over the top of the orchard trees would be as great as ever. See that a piece of woods next to your orchard does not subject some of your trees to frost injury.

FROST DAMAGE TO ORCHARDS

Orchard heating has been brought to a thoroughly efficient state during the last few years, in Colorado and the Pacific coast fruit-belts. It is a recognized feature of orchard culture there, and is included in plans of work to be done on the orchards just the same as are pruning and spraying.

Certain situations here and there throughout the country are so exceptionally favorable for fruit in other ways that planting in them is advisable, even though the situation is known to be frosty; or an orchard may be already located where blossoms are often frozen; or once or twice in a lifetime an exceptionally heavy frost may in blossoming-time visit an orchard that is safe all other years. In such cases artificial heating will save a great deal more money than it costs.

Sometime along in April or May there will be a few days of warm weather, with south winds and showers that will start buds and bloom. Then, in a few hours, the wind will shift to the north or west and blow the clouds away. A clear night and a bright morning will follow, but this is just when to look for the worst frosts. Have several thermometers here and there in the orchard and near your house, about six feet from the ground. Be sure your thermometers register correctly—some don't. When danger threatens, watch the thermometers carefully, especially from midnight till sunrise. Start frost fighting while the thermometers read a couple of degrees above the danger point.

The Irishman said it wasn't the fall that hurt him, but hitting the ground. So, it is *not* the freezing so much as the quick thawing afterward which causes the damage to blossoms. If we can get something to prevent this quick warming up, and make our frozen flowers thaw out gradually, we can reduce the final damage 75 per cent. Clouds will do this, and so will artificial clouds—smoke for instance—and smoke is just the thing wanted for other reasons.

Every one has noticed that the weather never gets very cold when the sky is overcast with clouds. We might say safely that frost never comes when there are low, thick clouds. Observation of this fact led orchardists long ago to adopt *smudging* as a frost preventive. The smoke makes a blanket which shuts out colder air from above during the night, then shields frost-bitten blossoms from the sun's rays in the morning, and allows time to warm up slowly.

Some growers have ready piles of wet brush, straw and leaves about the edges and throughout the orchard where the fires will not harm the trees. Sometimes oil is poured on these materials, but they should be kept as full of water as they can be and yet burn. When the temperature goes down near the danger point these piles are lighted. The moisture in the fuel is valuable in three ways—by increasing the volume of smoke, which covers the orchard, by loading the atmosphere with water, thus lowering the danger point, and by making the fuel burn more slowly and last longer.

Sometimes, when the frost danger is slight, a burning pile of wet straw on a sled or wagon hauled here and there through

the orchard will save much fruit. Elevate the material on screen wire and build the fire on a layer of earth in the bed under it. Where the heating has to be done for several nights in succession a mixture of tar, straw and sawdust will be found good. The ingenuity of the man whose crop is threatened can save him more dollars in this situation than in almost any other which comes up. Things have to be done quickly, and for every hour of time there are four hours' work.

Orchard heaters, made of sheet iron, in various forms, which burn coal, wood, or oil, always should be installed if heating has to be done each year. The study of heating by this method would make a book in itself. Get the catalogues of heater manufacturers, compare their products, then buy fifty or sixty or eighty heaters (one hundred or more if oil heaters) for every acre you have to protect. Get more heaters than you ever will need in one night. Put all the heaters in position long before the time they will be needed. Have fuel and everything else ready, then you can make your work effectual. Tanks, sheds, fuel, buckets, torches, etc., also are needed. It will cost from $500 to $800 to install and run for one year a heating equipment for ten acres.

A final word on artificial heating is this: With half-hearted preparation you cannot save the crop, and you will be out both the value of the fruit lost and the cost of the attempt to save it. Remember that you cannot raise the temperature of the air much by supplying actual heat—because, however hot the fire is, the heat from it will rush up above the trees and will be replaced by colder air pushing in from the sides.

Ninety-five per cent of the influence you can exert on the temperature will come from supplying moisture to the air, which lowers the danger point, and from covering your trees with dense smoke, thus preventing quick thawing. These two processes will accomplish the purpose if given a chance, but do not imagine that you are "warming all out-of-doors," as a great many people say. In some parts of the West a light spraying of water while fires are burning helps to protect trees. Spraying trees with whitewash in winter helps protect trees against sun scald, winter damage and spring frosts.

The mulching of trees while snow still is on the ground, to delay blossoming, is advised sometimes. A mulch that is thick enough will keep the ground frozen as long as two weeks after grass gets green on sunny places, but the leafing-out and blossoming of the mulched trees will not be delayed more than three or four days. The reason is that the first growth in spring—the first leaves and blossoms—is not fed from the roots, but comes directly from food stored in the wood of the trees.

You can prove this by pulling into a warm room in midwinter a branch of a tree which stands close to the window. Stop up the hole around the limb. In a week or two buds will begin to swell on the part of the branch inside, and in a month blossoms will open, even though the snow may be four feet deep outside. Or break off a twig bearing fruit buds, in winter, and put it in water in a warm, light room. It will bloom.

In Ontario, Michigan, Kansas, and other places where winters are severe, growers have found it practicable to protect their more tender fruit trees by training the roots to extend only in two directions; then, every fall before the ground freezes up, they dig a trench on one of the sides which has no roots, pull the tree over, and cover top and all with straw and earth. Peach and other trees will stand this treatment and will yield well under it. Orcharding is hard business under such circumstances, but growers in cold localities may find this method profitable when fruit brings high prices at local markets and where it is wanted at home.

SUMMARY

Cold and cool weather put quality into fruit, hence higher elevations and northern latitudes produce higher quality fruit than lower elevations and southerly latitudes.

Each mile north or south equals eight feet of elevation; or each degree of latitude equals 500 feet of elevation.

It is not necessary to lose any crops from spring frosts.

Proper care in locating trees, in cultivating, etc., will help prevent frost damage. Nearby bodies modify temperature. Air drainage is the prime frost-damage preventive, and is more important than exposure or soil or elevation. Air-drainage is governed by the lay of the land—by comparative elevations —and by draws, shoulders of hills, slopes, hollows, valleys, etc.

Test your orchard location with reliable thermometers.

Windbreaks prevent frost damage when they "*break*" the force of wind and do not altogether stop its motion. A piece of woods will cause a dead air-space, in which blossoms will surely freeze.

Artificial heating, when rightly done, is effective in preventing frost damage. Begin the work before the temperature reaches the danger point.

Get plenty of moisture into the air by wetting the fuel, or spraying trees with water. Moisture in the air lowers the danger point and prevents frost damage.

Quick thawing is worse than bad freezing. Cover frozen blossoms with smoke and prevent the sun from striking them in the morning.

Adding moisture and insuring slow thawing are the methods you have of preventing frost danger,—you cannot do much by directly adding heat to the air.

Planting

IN the spring of 1911, two men were driving past a neighbor's farm in a northern state, and were talking about the neighbor's new apple orchard, which contained five hundred trees, one year old. "He will never make anything out of them," said one man, "because one of the surest signs of what the future of an orchard will be is how it was started, and this one has been started wrongly in several ways.

"In the first place, his trees are propagated from inferior parents. Half of them he budded himself, because he thought he could grow them cheaper than to buy them, and he got the buds from the old Baldwin trees on the —— place. Those trees never did bear right. The other half were bought from a nurseryman that I know has little idea whether or not the buds used came from trees that bear regularly and well. Then he has set a solid block of the one kind. He has made other mistakes in planting, but these two have already condemned his efforts to failure."

This incident of wrong practice so impressed itself on our minds that we give it here. In the first place, you want trees that are true to name, and that *come from parents which bear big crops of flawless fruit.* We all know that no two trees in an old orchard bear the same, even if they are of the same variety. Some bear better than others. A bud will make a new tree having the same characteristics as the tree from which the bud was cut; so, right at the start, avoid one great limiter of your success—the poor trees—and give yourself *a chance* to succeed. Get trees that have been propagated from trees which are bearing, and bearing as they should. If possible, make the nurseryman tell you where his buds came from, and see these parent trees if you can.

It would seem almost foolish to tell an intelligent planter to be sure that his trees are true to name, yet recently we were in the packing-house of the president of a state horticultural society, who is himself a large grower. He had many bushels of very small, insipid peaches he was trying to get rid of. We asked him what they were, and he replied that they grew on trees he got as Crawford's Late, from a nursery nearby, taking their word that the trees were right, even while he knew *they* had not grown the trees themselves.

There are a few reliable *growers* of fruit trees in this country, and there are hundreds of irresponsible dealers, and growers who produce trees as cheaply as possible. Some of the dealers will buy a few thousand trees at wholesale from the unknown and unreliable growers, whose only care is to deliver *something* with a few roots and a top, and who care little what kind they supply, or what their trees will turn out to be, then "go into the nursery business" and say they "grow" first-class stock. The dealer cannot find out where his trees came from. Orders for different varieties often are filled from the same block of trees. These trees usually are offered cheaply, yet

there are plenty of instances in which they have been sold for almost double a fair price.

Planters can avoid all risk by buying trees from a nursery that, first, grows *all* its own trees, and second, gets its buds from *good* bearing trees, and *points out to you* those trees. This beats all hollow a guarantee to repay you for damage sustained by reason of wrong varieties. *Visit the nursery yourself and select your trees.* Get the best you can find. There is only a dollar or two difference between the cost of the best and of the poorest, and the ultimate difference to you will be many, many times this.

"The best trees" usually are of medium size for their kind and of the proper age. They are not always straight and clean. Some kinds do not grow that way. Bear in mind the nature of the variety, compare the different trees you see of that same kind, then pick out those that look best to you. Vigor, cleanliness, health, good roots, and firm, hard, well-ripened wood are much more important than size. If you buy from a nursery that grows its own trees, and takes the trouble to keep track properly of its buds, you can depend on it to do the budding right and deliver to you trees which are as sound as they can be grown.

It is generally best, especially north of Virginia, to order trees in late summer or early fall, and have them delivered to you either in time for heeling-in that fall, or have them dug and heeled-in at the nursery for you, then shipped as soon as zero weather is past, in time for planting the first day in late winter or early spring that the ground is in shape. *Cover tops and all with dirt when you heel-in, use no straw.* Fall planting is good if done at the right time and if trees are in good shape. In an average fall, there is only a week or so during which planting ought to be done. Fall-planted trees make some root growth during fall and winter, but spring-planted trees, if put in early enough, will be safer, and will not be behind those planted the fall before, in growth. In the fall you get the pick of the season's tree crop, and planting is not delayed because you do not have trees at the right time. Try to get low prices, but *still* do not buy trees because they are cheap. Frequently the advice is given to buy trees of the nearest nursery. That is mighty poor advice. *Buy trees from the nursery best equipped to produce good trees. Buy the best trees you can get.* Don't worry about the distance away or about getting the trees to your place. Good packing will bring trees in perfect condition anywhere. Freight charges across the continent are no more than two or three cents a tree and through a half-dozen states they are likely to be only one cent a tree.

This book is a fruit-grower's guide book, and we have tried to keep it clear of any reference to our own business of growing trees except to give our experiences for your benefit. But here we want to tell you, as a fact valuable for any planter to know, that we can give you the pedigree of every tree we sell. We will show you the parent tree or trees, if you care to go to see them, bearing in the most successful orchards of the coun-

try. We grow practically every tree we sell, and we have a system that almost entirely eliminates any possibility of mixing varieties. More than that, we handle immense numbers of trees every season, and the feeding, cultivation, digging, packing and shipping are done in a manner better than any firm operating on a smaller scale can do these things. We know this, for now we do many things that are to the planter's advantage which we could not do a few years ago, when we were smaller.

Cross pollination is a subject too little understood. In the chapters on each fruit we say that the only safe way is to alternate different varieties to a certain extent. Put a row of a different kind every three, four or five rows. About one hundred and fifty feet is far enough to depend on pollen carrying. Insufficient pollination will result, first, in entire lack of fruit; and second, in weak setting of some fruits, making crooked, gnarly individual specimens the rule.

Blossoms are of three kinds. One class is perfect; that is it contains within its own borders both the male and the female elements. This kind of blossom may or may not be able to fertilize itself; sometimes it can, but often it cannot, as in the case of the large majority of apple blossoms. A second class of blossoms is male; that is, it has only the stamens—the little upright hairs that you see in the middle of the flowers. A third class is female only, and has no stamens, but merely a fleshy growth at the bottom or center of the flower. With the exception of the kinds which bear both male and female blossoms on different twigs, and a very few which are able to fertilize themselves, all other kinds, of any class, require a variety of the opposite class near enough so that some of the pollen from the other kind of blossoms will reach their blossoms with the help of wind and bees.

Certain varieties have blossoms, perfect to all appearance, yet are impotent in so far as their own blossoms are concerned. There are many affinities among the different varieties. For instance, Bartlett pear is fertilized best by Winter Nelis, Kieffer by LeConte, Stayman Winesap apple by Duchess or McIntosh, and so on through the list. Whatever you are planting, see that you set trees of different varieties within reach of each other, and also that their times of blossoming come together; that is, set near each other two early bloomers, or two late bloomers, but not an early- and a late-blooming kind. Select the varieties before you go to buy. Determine what you want, with reference to all the conditions that will have to be met, then get those kinds. In this way you will have no trouble about substitution of varieties in filling your order.

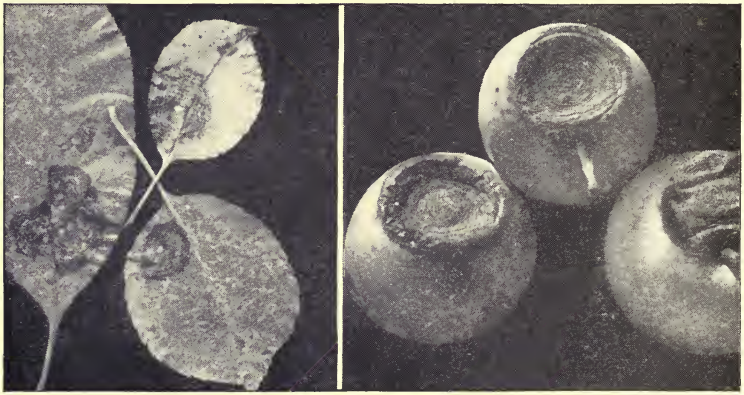
Select the location for your orchard with reference to exposure; to air-drainage and other frost-damage factors; to the character of the soil, and particularly the nature of the subsoil. Roots have to go down three or four feet. If there is close underlying slate or hardpan, avoid that land unless you break up this hardpan thoroughly and permanently. The section of the country is of little real importance. Delaware orchardists are near markets, and their soil is worked easily. West Vir-

Spraying-house of a large orchard. Note elevated tanks for water and mixtures.

Top-worked trees; left, three years from graft; right, five years. Both bear.

Badly split tree saved by bolting Good for a lifetime yet, and worth $50.

Left: Leaves affected by cedar rust. Right: Leaves and fruit affected by blotch.



Left: Frog-eye fungus on apple leaves. Right: Characteristic bitter rot

Left: Scab on leaves and fruit. Right: Curl leaf fungus on peach leaves.

ginia and Pennsylvania lands are high and grow the best quality of fruit; New England is farther north and claims superior flavor and keeping qualities; Oregon is far west and claims superior color. Whether much or little is in these claims, what is lost in one place is balanced by a gain in another place. So, plant your trees where you can do it best.

Avoid setting trees too close together. They feed over a wide area if they have the opportunity, and they are the better for it. Our plan is to set three peach trees to one standard apple. Where peach trees are used as fillers, we get from fifty to two hundred trees on an acre, depending on many things. With apples you will get more cash returns from thirty trees on an acre, in the East, than from sixty on an acre. Some varieties, however, are naturally smaller growers than others, and can be planted closer; also the section has something to do with it. For instance, trees grow bigger in Pennsylvania or Delaware than in Michigan or the West. The system of pruning you are going to adopt, as well as the price of land, has something to do with the distance the trees should be apart. Leave plenty of room for spraying, cultivating, driving about with wagons, etc. Keep the trees far enough away from boundary fences, and never plant them closer than forty feet (one hundred feet is better) to thick woods or an evergreen windbreak. Privet needs only twenty feet, and in most sections is as good as any known plant for windbreaks. Fillers, of course, alter the distances given, as they merely occupy the ground before the premanent trees get big enough. The following gives the shortest distances at which trees should be set:

Apple trees need fifty, forty, or thirty feet between one another, depending on various conditions named above (dwarfs ten to fifteen); pears twenty, twenty-five or thirty; quinces fifteen to eighteen; peaches thirteen, eighteen, twenty-one to twenty-five feet; plums fifteen, twenty to twenty-five feet; sour cherries the same as peaches, and sweet cherries the same as pears (in some sections forty to fifty feet); grapes should be put six by eight feet to eight by ten feet; strawberries from eighteen inches each way to one by four feet; raspberries from three by six to five by eight feet; and blackberries from four by seven to six by nine feet.

Fillers always are to be recommended to careful growers. If you think you will not use your trees right while they are growing, or that you will lack the determination to cut out the nicely bearing fillers when they are about twelve years old, do not plant fillers, for these things must be done. But no business farmer will think of going to the expense of growing a first-class apple or pear orchard without planting early-bearing sorts of these same fruits, or of peaches or strawberries, between his permanent trees. To use fillers makes the orchard a paying investment considering it on a five- to eight-year basis; while without them you will have to take fifteen years, or even longer, as the time in which you are "starting" your future orchard, or before you get back the entire cost and begin to see a yearly surplus.

The following table gives the number of trees that can be set on an acre by the square method, and by the triangular, (called quincunx, or hexagonal also) method:

	Square method	Triangular method
40 feet apart	27	31
35 feet apart	35	40
30 feet apart	50	55
25 feet apart	70	80
20 feet apart	110	125
18 feet apart	135	155
15 feet apart	195	225
12 feet apart	305	350
10 feet apart	435	505
8 feet apart	680	675
6 feet apart	1,210	1,600
5 feet apart	1,745	2,010
4 feet apart	2,725	3,145
3 feet apart	4,840	4,890
2 feet apart	10,560	12,575
1 foot apart	43,560	50,300

Trees sometimes can be planted to advantage farther apart one way than another. To do this, you have to work out the plan for your own orchards. This plan works best on steep hills. The rows should follow the lines of the hill to make driving easier. No rules can be laid down for hillside arrangement. Use some modification of the plans given here.

The triangular method of arrangement is the best for those trees which should have more than eighteen feet between. We illustrate it here. The square system and the many variations of each system are not shown, as they are very simple and are understood everywhere. In the triangular system each tree is at an equal distance from all of its nearest neighbors, and all of the ground is used as completely as it can be. In the square system, the diagonal distance across the squares is longer than the sides, so there is waste space in the middle of the square. To mark out the position for trees by the triangular plan, set stakes along one side of your orchard land, just where the trees are to go. Then, with two helpers, take a wire a little longer than the distance you want the trees apart, put a loop at each end and one in the middle, leaving the length then just exactly right, and direct each of your helpers to take an end loop and hold it at a stake. You, with the middle loop, will step out into the field, and when you have stretched the wire, you will have the exact place for the tree. Drive a stake there, and continue in the same manner all the way across the field. Many variations of this can be practiced. Do not use a strap or a rope, for they will stretch. A single wire, to go to one stake, will do, if you cannot get more than one helper. In that case, mark a semicircle with a stick in your loop, about where you think the place is, then send your helper to the second stake and make another semicircle. Where the marks cross is the place for the tree. This plan will work perfectly on hills and rough land.

You also can fix the positions for the first few trees on an end and a side with a tape or any measure, and then, from these,

get the distance between the *rows*, or *lines*, of trees, directly, and set stakes at the ends of these on all four sides; then plow furrows, or stretch a wire (about No. 14, with drops of solder and colored strings wrapped on the proper distance apart for the trees) completely across the field where the row will stand, and put the trees the distance apart decided on originally. The square method of setting is simple, and, if it is wanted, any one quickly will think of an adaptation of some of these plans for getting the position of each tree. A way to avoid setting a stake exactly where the tree is to stand is to set a row of stakes entirely around the orchard land, and then set two rows entirely across the middle, in opposite directions, being careful to get these center stakes *between* tree rows.

Anywhere you look, in this way, you will have two stakes to sight by. The stakes can be so arranged that trees can be set either on the square or triangular plan, by carefully thinking out beforehand in which directions the rows will run, and the positions of the trees, then setting the stakes accordingly. If you adopt this plan, and keep the stakes away from the position for the trees, you will not need the following. But it takes a good eye to set trees straight in holes, and here is a surer plan: After you have a stake *exactly* where each tree is to go, get a board seven feet long, with a wooden pin about six inches long sticking down from each end, one pin tight, the other loose, and with a deep notch in the middle of the board. When you dig the tree holes, first lay this board down (always with the same side up and notch ahead) with the stake in the notch, push the pins into the ground, then pull out the stake, lift the end of the board which has the removable pin, and turn it around out of the way. When you are ready to plant the tree, bring the board back again, drop the end with the hole over its pin, which is still sticking where you left it, and set the tree with the trunk in the notch.

Where there are more than a couple of dozen trees to plant, it is best to *double-stake* the whole orchard before holes are dug. This is the way to do when you use dynamite in digging the tree holes. Instead of having one pin solid in the board, merely have two holes through which to drive small stakes that are left at each hole. After the holes are blown out or dug, and when you go to plant, put the board over the stakes again, and get the exact position for the tree at the notch.

Unpack trees as soon as you get them, unless they are frozen. (In that case let them thaw out *slowly* in a cool cellar.) Shake out packing material, dip the roots in mud, and either plant or heel-in at once. If you heel-in, cover tops and all with dirt. Young trees should be well cut back at the time of planting, as directed in the pruning chapter, in order to get a balance between the amount of roots and the amount of top. Half, or more, of the roots always are destroyed in digging trees, even with the most careful work that can be done, so we must cut back the top to correspond. All damaged roots should be cut off smoothly with the slant on the under side. The tops should be cut down to where you want the heads to start

(usually twelve to twenty inches from the ground.) This can be done best a week or a month after the trees are set. The branches should be shortened at the same time.

Dip the roots into thin mud, spread them in carefully prepared holes (dynamited if possible) that are wide enough and deep enough to hold the roots without cramping. Work good, fine dirt in among the roots thoroughly. Ram it in with a stick. Move the tree up and down repeatedly. Pack the dirt well. You cannot get it too solid about roots, except two inches on the surface, which should be loose. Use your whole weight, or better, pack with a heavy maul. Leave no air-spaces.

Do not let the roots lie exposed to sun or wind. *Never let them dry.* Cover the roots with a wet blanket, pack them in a tight wagon-box and cover with dirt or wet straw, or load the trees into a barrel filled with water, and, as planted, pour a little of the water about each one. Trees should go just a little deeper than they were in the nursery. Watch the dark line of bark at the base, and put this an inch below the surface. It often is a good plan to use water in planting. The surface of the newly dug earth, for a couple of feet about the little trees, should be covered with a six-inch mulch of straw or leaves, to retain the moisture. Trees will need no fertilizing till the second summer, when a little nitrate of soda or horse manure will do good work.

SUMMARY

Get trees that you know are right—the importance of this cannot be over emphasized.

To be sure of reliable trees you must buy them from a firm that is responsible—that knows how to propagate trees, works by a system that prevents the possibility of mistakes, and backs up their stock till it bears.

Good trees are true to name, and are propagated from parents that bear heavy crops of flawless fruit. See the parent trees whenever possible.

Always visit the nursery and select your trees yourself when it is possible. It pays.

Buy the most vigorous, cleanest, healthiest, best ripened, biggest rooted trees you can find anywhere—the best will cost only a few dollars per hundred more than poor ones.

Select and place your trees with regard to cross pollination. Lack of pollination is a frequent cause of small and poor crops.

When you plant, consider air, drainage, soil, etc. Always arrange trees by a handy system, and put them far enough apart.

Use fillers—and cut them out in time.

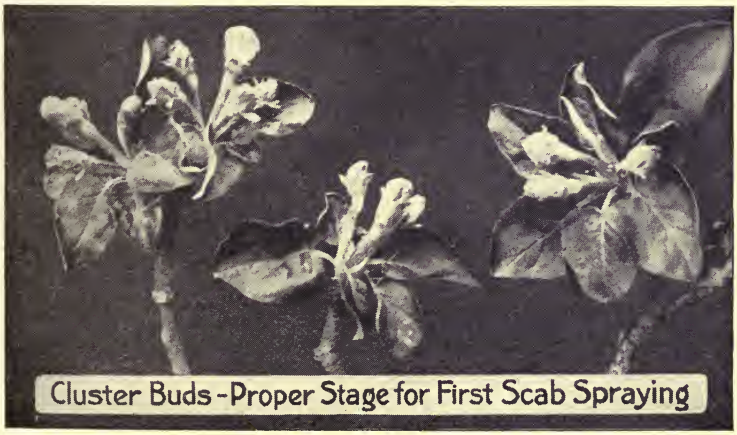
Trees must be planted just at the right time. A dollar's worth of care in planting will save many dollars' worth of trees. Follow the suggestions given here.

Don't forget to mulch newly set trees.

We plant standard apple trees 20 by 20 feet, and cut out fillers when 12 to 20 years of age.

Caused by woolly aphis, by partially freezing buds, winter or spring, and by poor pollination.

San Jose attacks both bark and fruit, and infects Ben Davis very badly.



During only two to four days are the buds in best condition for this spraying.

Put the material on with force, drive it into every nook. Get a machine that will do this.

Blossoms—Stage to spray for codlin moth. Four days later half the worms would escape.

A practicable spraying outfit for small orchards, and where trees are small.

Pruning

FEW understand what pruning really is, hence it is necessary to explain from nature. To cause trees to reproduce themselves is Nature's principal object; she bids each grow high and thick as rapidly as possible, and produce as many seeds as possible, without regard to the flesh in which they are contained. A tree will produce a thousand seeds for every one that possibly could find a place to grow. The stronger choke back the weaker and all damage themselves in the struggle for existence.

In the orchard we have left nature's plan behind, and the trees no longer have to fight for space, light and food. In the sunny, cultivated spaces, where they are not kept back by one another, they grow too fast and too much, and naturally produce too many seeds. This brings the necessity of pruning and thinning, or, rather, the necessity of training the trees to so shape themselves that they will ripen the largest number of heavy-fleshed fruits, with less regard to seeds.

We prune, therefore, to modify the vigor of trees; to make them produce larger and better fruits; to let the sunlight in to every leaf and fruit; to change their habit from wood-making to fruit-making, or from fruit-making to wood-making, as required; to remove useless, harmful or injured parts; to give trees a longer life; to keep trees within manageable size to make easier the spraying, cultivation, harvesting, and to train them to a desired form.

Trees are living things, and are affected by everything we do to them. Too often they are used as though they were dead posts. We cannot remove a single branch without modifying every other branch on that tree. A tree thus can be trained or molded to a remarkable extent, and he who prunes intelligently will surely get good results.

But pruning has to be learned by experience. We can explain the principles, but to acquire skill in accomplishing the results you desire, you must do the work yourself and watch the effect from year to year. No two trees are alike. No two branches are alike. The rules laid down must be modified to fit each kind of tree and even each single tree. For instance, Kieffer Pears must be handled differently from Seckel; Spy apples differently from King. To work over a tree and give it the care that it needs, as an individual, is one of the most fascinating operations in orcharding.

Think first of securing the best possible shape and size. For all practical purposes and for most trees *a low head and an open head* is what you want—low, because you can work over it better; open, to let the sunlight and air reach all the leaves and fruits. (Trees feed from both roots and leaves.) There are other considerations, such as having the head well balanced, good to look upon, and carrying the largest possible amount of fruit-bearing wood that the roots can feed; avoiding forks that will split apart under a load; keeping branches growing into the prevailing wind and away from the morning

sun (against tendencies to the opposites of these), and leaving space under the branches for horses and tools.

Keep these words before you as you work about the trees—"*a low head and an open head.*" They will suggest the removal of this and of that little limb, the pinching of tips here and there, the *leaving* of others. A well-trained tree that has reached bearing age in good form can be kept right with very little cutting afterward. Few trees need central leaders—only those of the plums, pears, apples, etc., which grow very upright in the spring, and then spread away out as the fruit develops. Some horticulturists advise us not to remove big limbs when we can avoid it. We do not agree with that, for limbs should be removed when there is a reason for it, even if they are a foot thick. Of course the work *must be done right*, as explained later. Still, the time to remove limbs is when you can do it with your fingers—pinching buds—or with light pruning-shears or a pocket-knife. *Direct* the growth to where it is needed.

Remember this: A limb never gets any higher from the ground that it was when it started. Decide when you plant and first prune where you want the head of your trees to start. Some trees have to be cut back to a mere stick, as is correct with peach; with other kinds, such as apple and quince trees old enough to be branched, you have to select, then and there, the limbs you want for the framework of the head, and nip these back to buds growing in the direction you want the branches to continue. One big grower likes to have one main trunk from which the five or six frame-limbs grow out in a rising spiral; others prefer to have all the limbs start at nearly the same height; but all agree that no two limbs should be *opposite* each other, because this will form a fork that will split.

Trees are just as free with their buds while young as they are with seeds when older. Hundreds of buds are produced for every branch or blossom that can grow. We do not even see all the buds; you can remove every one you can find, yet by the next season the tree will have brought to light more dormant buds than you removed. Because of this you can train twigs and branches to grow into almost any direction you wish. It is not a question of pruning as little as possible; it is a matter of selecting the one bud out of a hundred that is to live; and *you* want to select this bud, for if you do not, nature will for you, but probably not in the way that is best for producing fine fruit. Do not think you can keep *all* the growth a tree makes, or nearly all. Make up your mind that a good part of it must die, from one cause or another. It is the law of nature. You must direct the growth into a proper form.

Certain tendencies of trees must be remembered when you cut off buds or branches. First, a young tree is likely to grow faster than an old one, therefore it requires more heading back than an older one. Any tree will try to grow first from its topmost or outermost buds. *Always cut to a bud or branch,*

and to one that grows in the direction desired. (Three-eighths or a quarter-inch above the bud is the proper distance to cut.) The tree will throw its sap into this bud or branch and develop it with all the strength formerly given to both it and the part removed. Direct the shaping of your tree by following this rule. In cutting leaders or shoots, remember that the natural habit will be to grow straight on. Thus, if you cut a tall-growing shoot on a two-year tree, you probably will find another shoot extending straight on up the next season, with only a slight offset where you made the cut.

By keeping the center open, you will avoid nearly all crossed limbs, but where these are found, one of them always should be cut out. When you find two limbs growing parallel, cut away one. You can have a "double-decked" tree, but you cannot succeed with a three- or four-decked one. When there are more than two branches between the earth and the sky at any one place, remove all but the best two. Never cut a good limb that is in the right place in order to get under it with a horse. The limb is worth more than ten times what the cultivation would be worth. Mulch under that limb. The tallest apple trees should not be more than twenty feet high. When they become higher than this, head them back once or twice a year, and keep them down to workable size.

Just as stronger, bigger trees will overshadow and dwarf the leaner ones beside them, the lusty limbs or buds will stunt and starve out the smaller ones on the same trees. You must keep a balance between the various parts, or the biggest ones will get still bigger, and the smaller ones smaller yet. Water sprouts should be nipped when they start, unless the tree needs new limbs where they grow out.

These principles will enable any one to go to any kind of a fruit tree, and, after a little study, train it into any desired shape as it grows. To make the tree bear fruit, and fruit of the finest kind, other elements and habits are to be considered. But, in all pruning, remember that constant watching is best. Go over your trees at least once a year, twice if possible, giving them the nips they need. In this way little heavy cutting will be required, and the total amount of work will be lessened greatly. Ten minutes to a tree twice a year will accomplish much more than two hours to a tree every two or three years.

Study of the fruit buds will open the eyes of many growers, first as to their method of growth and life, then as to their location. Fruit buds are usually thicker and fatter than leaf buds, and have a shorter point. You can learn to tell them apart by studying the trees in the fall and spring. We do not have space here to explain the full process of their formation, but we can say that fruit buds and leaf buds are transformable to a certain extent. If the growth of a shoot is not checked, all of its buds will make branches. But nature asserts itself; certain buds are checked by stronger ones, even after they have developed into little branches, and these dwarfed buds or branches, since they cannot make new branches of their own, turn to the other work of a tree—seed-producing.

The first few years of a tree's life should be given up almost entirely to building a frame on which to bear crops. Disappointed branchlets along the inside limbs may produce a few fruits, but until the tree is rather large it should devote its energies to growing. After the tree is large enough, however, fruit-bearing is the thing for it to do, and more growth should be discouraged. On the ideal tree there should be just enough new growth to replace annual wear and tear. Of course more will grow, and this will have to be cut back or the trees will become too large, meanwhile neglecting the work of fruit-producing. What you want to do is to *disappoint* the great majority of buds, and thus make them change their leaf and branch buds to fruit buds.

This checking of the growth can be accomplished by tipping back each season's growth a certain amount, depending on the kind of tree. The very best time to do it is after the fruit has set tightly, *as you are thinning.* Trees stop their season's growth much earlier than is ordinarily supposed, and if you cut off half or more of the length of the shoots some time in June or July, you throw the energies of the tree into the forming of the fruit. As your tree is big enough, you do not need more wood, so the various processes work together. In the same way, all summer pruning makes for fruit-bearing and fruit-developing. If you were to prune large trees in the winter, the sap, when it came in the spring, immediately would go to replacing this wood, thus giving each remaining bud a *better* chance of becoming *a branch*, its first desire, and lessening the number and vigor of those buds that devote themselves to producing fruit. (Wounds made in winter and subjected to freezing require twice as long to heal as summer wounds, and many never heal properly.) We recommend that pears and apples, especially, be tipped back in June.

Fruit buds usually are thicker and more blunt than leaf buds. In winter you can distinguish them easily by their appearance. The aim should be to have as many fruit buds scattered *all over* the trees as possible. There should be no long stretches of bare limbs. To make fruit spurs, merely pinch off the end buds of little branches, instead of cutting the whole branches off close to the limbs from which they grow. If you do this, and afterward avoid breaking the spurs thus formed, you will have fruit all over the tree, and these spurs never will get much bigger than they need to be to support two or three fruits.

This brings up a point that must be remembered. Apples, pears, cherries, plums, etc., bear their fruit only on wood that is two or more years old. Peaches bear only on one-year-old wood, while American grapes and quinces bear on wood of the same season's growth. When you prune *always remember* how old the fruit spur must be in order to bear, and arrange in advance for the formation of more and more fruit spurs. As explained in the thinning chapter, two or three years are required to develop most fruit buds (excepting peach and grape) to the point where they blossom. Unless careful thinning and growth-

checking are done, the production and ripening of one or two fruits on a spur will prevent that spur from working ahead to develop fruit buds for the next and the second year ahead. This it has to do if it is to set fruit again before three years.

Judicious tipping greatly helps fruit spurs to keep on forming new fruit buds, and, of course, thinning the fruit aids greatly. Still, it is a good plan to see that each year there are large numbers of fruit spurs which do not bear at all. Let some ripen the crop for next year, others the crop for two years ahead, and still others the crop for the third year to come. By careful pruning you can develop on your trees enough fruit spurs to do this. But it takes study and care—not so much work at any one time as a few minutes now and a few again. *Watch your trees expanding and growing.* The trees will develop the *fewest* possible *fruit spurs* if left alone—you want them to develop the *greatest* possible number.

The healing of wounds must be considered if pruning is to be productive only of good. In order to find how to make cuts that heal the quickest, let us examine into the method of growing a bud or limb. Close to the heart of the limb or trunk a tiny knot will form, and grow out through the wood to the bark. After this the projecting knot will have bark of its own. For our purpose it is correct to think of each bud or twig or limb as a thing in itself, just as though you bored a hole in the parent stock and drove a wooden plug in. When this projecting limb (small or large) is cut off, the part within the parent wood dies. It is not altogether a part of the trunk or the old limb. If the cut is made *close* to the trunk or old limb, however, bark from *it* will grow over the end of this dead wood inside, sealing it up entirely and keeping out water, bacteria and fungi spores.

Bacteria act on an exposed dead stub of a limb exactly as they do on a piece of wood in the soil, disintegrating it and "rotting" it, thus leaving a hollow into the heart of the tree. Part of the dead stub merely dissolves in water, the same as salt will. After the bacteria come the fungi, which tear down (rot) the dead stub with their roots, exactly as the grass and tree roots help pulverize and tame earth. The bark on the parent stock grows over a wound by callousing—that is, by forming a swelled ring around it, gradually closing in more and more until the surface is completely covered again.

The tree can do this healing easily *if the wound is close to the surface and parallel with it.* It cannot do it if there is a stub; therefore cut closely. No matter if the surface of the wound is larger, saw right through the thick part at the base, and *cut closely.* Make a cut underneath the larger limbs, to prevent splitting down,—such a split is inexcusable on a fruit tree. Winter pruning is bad, because the tender bark freezes and kills back from the edge of the wound, making healing more difficult. Every wound larger than a quarter-inch should be covered with some substance that will keep water out and protect the raw surface from the air (preventing evaporation) and kill bacteria and spores of fungi. *Raw* linseed oil paint is very

good, grafting wax is better, and even clay helps. Tar and some other substances injure the bark. Do not neglect this painting over of the wounds, as it is one of the most important operations connected with pruning limbs thicker than an inch. When tipping back, cut about one-fourth inch above a bud or branch. This stub will then live and heal over.

Except at planting time, when damaged roots should come off, with a slicing cut that leaves the slant under, root pruning is to be avoided in the East and North. It is of practicable benefit only when the soil is very loose, rich and warm, and the climate almost subtropical. Along the Atlantic and Gulf coast, in the southern states, a practice of cutting all roots back to six inches, or even shorter, is sometimes seen, but there is little excuse for this. Better keep all the perfect roots you can.

We do not say much here about the tools to use in pruning, or the methods of cutting, etc. Those things can be decided by every grower. Saws, shears, axes, knives and other tools of all kinds are at his command. We picture some in this book. If wrong cuts are made, limbs allowed to split down, or ragged ends left projecting, the operator is not a good fruit-grower, that is all, and no amount of suggestion will keep him from failure. *Study your trees and train them as you would a child*—that's the way to succeed.

SUMMARY

Trees produce a thousand seeds and a hundred buds to every one that can possibly find a chance to mature. Pruning is a question of selecting this one out of a thousand that will accomplish best the result we want. Proper pruning *directs* the growth to where you want it by disappointing buds that start in other directions and with other aims. It is foolish to think that trees will naturally grow into the best shape, for nature's plan is to make trees thick and big as fast as possible, while modern orcharding demands trees that are low and open, and demands large, flawless fruit instead of little, imperfect fruit.

Adapt your pruning to the habits of the trees. For nine-tenths of all trees *a low head and an open head is the best possible form.*

Go over trees often. Do your pruning by pinching tips, rather than by sawing big limbs after they grow in the wrong place. Young trees must be pruned *right* when they are planted (headed from twelve to twenty inches from ground, and branches shortened) and must be gone over twice a season for a few years. Prune bearing trees every year. They will not need much if properly cared for while young.

Summer pruning results in more fruit buds; winter pruning in more wood growth. Aim to make young trees *grow*, and older ones *bear*. You can do this by varying the tipping back and cutting out.

Wounds made in winter are hard to heal. All large wounds

should be painted. Cuts should be made close to trunks or limbs and parallel with them.

Watch trees expanding and growing. Live with them. Train them as you would a child. It is tree nature to develop the *fewest* possible fruit buds—you want them to develop the *greatest* possible number after the trees are big enough. The way to take advantage of every possible inch of tree growth is to direct it often in the way you want it to go—work over trees several times a year

Quality Fruit, Crops Every Year

CULTIVATION, pruning and spraying will cause fruit trees to set heavy crops regularly, and, even if neglected, trees will load their limbs to the ground every three or four years. Here is a danger that, when not guarded against, will defeat the purpose which all orchard work is intended to accomplish.

We care for fruit trees in order to get as much as possible of the finest grade of fruit. Now, trees will not bear every year if they are allowed to mature all the fruit they set, or all that does not drop off naturally; nor will they produce much except small, inferior fruit.

An apple tree will start twice as many little apples as it is capable of "raising." A peach tree usually sets ten times the number of peaches that it can develop and mature properly. Other fruits will act in the same way. Because of this *growers must thin their fruit.*

We may compare the habits of trees to certain facts in the animal kingdom. If a flock of Wyandotte hens are fed right and housed properly, and if their eggs are taken from them every day, they will keep on laying, summer and winter. But if these same hens were allowed to keep their eggs they soon would want to hatch. Each hen would lay a nestful of eggs, and then would sit on them until her breast was nothing but skin and bone. Probably she would raise, each season, two or three broods of scraggy, lousy, nondescript chickens, which minks and hawks could catch easily. It is the same with all animals. If they breed to excess, they not only destroy their own bodies, but their offspring are far from perfect.

With trees, it is the production of seeds which uses up vitality and plant food. If trees are allowed to develop and ripen only a limited number of seeds, they will build large, flawless, high-colored, rich-flavored fruit; moreover, they will produce such crops every year. If they ripen too many seeds, they will exhaust themselves and will produce only a small quantity of perfect fruit.

It takes a tree two or three years to develop an apple, pear, plum, cherry, or other fruit, on wood old enough to bear. (Grapes, peaches and quinces require one year.) We do not

see this growth during the first year or two, as it is going on in the fruit spur and the bud. We must understand it, however, and plan for it when we want the biggest crops. (For an explanation of the difference between fruit buds and leaf buds, see the pruning section.)

A fruit spur usually has several fruit buds, all of which blossom, and most of which set fruit and make a cluster. The rule for thinning is to remove fruits until they are no closer than four to six inches, doing the work as soon as they are large enough to be found easily—the size of hickory nuts—and as soon as the fruit has set tightly. If this is done, only a tenth or a twentieth of the buds will mature fruit, although nearly all are likely to set fruit at the beginning of the season.

As soon as the baby fruit is taken off, the other nine (or the other nineteen) buds will proceed to start fruit for the next year or the second year, while the fruit allowed to hang on is growing and ripening. A reserve crop always will be coming on if proper thinning is practiced before the surplus fruit has had a chance to exhaust the vitality of the buds, and this will make certain the setting of a crop of fruit on that tree every year.

Thinning saves the tree, and by reducing the amount of energy which the tree puts into growing its crop, actually saves in fertilizer. It has been demonstrated frequently that a fruit tree on which thinning has been done correctly needs only half as much potash as is required by another on which the fruit has not been thinned.

Thinning would pay even though it should reduce the total number of bushels by half, but it does no such thing. We have seen trees from which 800, 1,200, 1,500 1,800,and up to 2,000 apples by actual count, each, had been thinned. Often fewer were left on than were taken off. But it was found at the end of the season that the trees had put enough extra size into the apples remaining to make up for the difference in the number.

When a tree starts to develop 4,000 apples, take 2,000 of them off, and the remaining 2,000 will make as many bushels as the original 4,000 on that tree would have made. If apples are thinned to six inches apart (other fruits in proportion), the number of bushels will be changed but little; if they are thinned to three inches, practically the same bulk will be borne, there being more apples, smaller in size. Thinning within reasonable limits influences the *size* and *quality* of the apples but *not* the number of bushels.

It is certain also that when fruit is thinned those left will take on a higher color. A more correct way of describing the process is that the color comes earlier in the season. All fruits would color up in time, but winter comes on, and time is a thing fruit does not have. Ripening on thinned trees is more thorough and complete. Few apples will be ripe one side and green the other; nearly all will be colored naturally and handsomely on both sides, and be ripe throughout.

One reason why thinning is so effective is due to the fact

that trees feed from both the roots and the leaves, as no one now disputes. At the stem of every fruit is a bunch of leaves. Sometimes there are half a dozen, sometimes only one, *but those are the leaves which mainly feed the fruit.* (A smaller amount of nutriment is drawn from any leaves within a foot.) Prove this for yourself by pulling those stem leaves off several twigs. You will find that without them the fruit will stay small and green. Think then, how, when there is only one apple every six inches, each will have a dozen or more leaves feeding it, and consequently will develop to its fullest extent. This simple fact explains a great many things, and if we bear it in mind we easily can better the quality of many bushels of fruit as we work about the trees.

The proportion of water in fruits will vary, of course. Apples have about 87 per cent. Now, since fruit is made up so largely of water, it costs trees very little to develop the *flesh*—so little, in fact, that we can almost overlook the plant-food required. Thus, any given number of big apples does not use up five per cent more plant-food than the same number of small apples. All this extra size and color and flavor costs practically nothing. It is to be had for the taking. Even the work of thinning is only doing in June labor that would have to be done anyhow in September or October. The other two thousand apples would have to be picked when ripe, and it does not require any more *time* to pick big apples than it does to pick little ones.

All wormy, small and inferior fruits should come off first. This will destroy an immense number of insects and fungi spores, just at the stage when it will do the most good—getting rid of the next generation before it is hatched. Good fruits should come off next, until only one remains of the cluster, and until the fruits are far enough apart.

Fruit on tips of long whips should come off, too, as it will not develop into fancy specimens. If, after thinning to the regular distance, so much weight remains that the branches require props, thin some more. Props are a sign of poor orcharding. Don't be afraid of taking off too much. Harden your heart and snip ahead.

Thinning the fruit on young trees is a necessity. Three- or four- or five-year-old trees often will stunt themselves seriously by maturing all the fruit they set. On two- and three-year-old apple and pear, and on one- and two-year trees of other kinds, the blossoms should come off, not even waiting for fruit to set.

It costs from ten to fifty cents to thin a twenty-year old apple tree. Stone fruits can be thinned by pulling the fruits off, while apples and pears will have to be cut off with shears. But mark this down and wear it on your sleeve: *don't damage the buds from which you take fruit. They are your next year's crop.*

By thinning, you can make your entire crop bring 20 to 300 per cent more than it would without thinning. You can have $1.50-bushel apples, instead of the 50-cent kind. Thinning

would pay if you would get only half as many bushels, because five bushels of large, perfect apples are worth more than ten bushels of small, inferior ones.

It is almost impossible to grow first-class peaches without thinning, and equally difficult to get good plums. With grapes it is no less important, but they should be thinned by winter pruning. Cherries and pears require less thinning than other fruits, but still they need it and cannot do nearly so well as they should unless they get it.

SUMMARY

To get heavy crops of flawless fruit every year, when other conditions have been met, thinning is necessary.

Fruit trees naturally will set twice as many fruits as they can mature perfectly. Unless removed, these will devitalize the trees, exhaust the fruit buds, and then grow into imperfect, small fruit.

By taking off half an ordinary crop, we do not reduce the number of bushels, but increase the size of each remaining fruit.

High color, rich flavor and perfect form are insured by directing the whole energy of the tree into a limited number of fruits.

Only a half or a third of the fruit buds on a tree should bear each year. The others should be developing for the next two crops. It takes most fruits two or three years to develop.

Never let trees that are too young mature many fruits.

Remember that the big profits come only from fine fruit, and that to get it *you must thin* intelligently.

Take off all fruits that grow closer than from four to six inches. Leave only the finest specimens—removing damaged ones, smaller ones, those on the ends of long whips, etc. Do it soon after the fruit has set tightly, when it is about as large as hickory nuts.

Living Enemies of Trees

ONE of the fourteen essentials for fruit-growing mentioned at the beginning of this book was absence of enemies. When a grower has mastered the methods of producing good fruit, and has trees coming on nicely, his work is not done, for he must overcome a lot of bugs and diseases which will stunt or kill his trees and prevent the growth or ruin the quality of his fruit if they are left alone.

Most fruit-growers are convinced of this. The following paragraph is not for them. But still many farmers point to the fact that until a few years ago no spraying or other fighting was done, and say it will not pay now. These men have an honest idea that spraying is a fad which soon will cease to be

popular. Owners of old trees and planters of new orchards are especially likely to neglect this work, giving themselves the comforting assurance that they, anyway, do not need to do it.

Such a course causes all kinds of trouble. Enemies get a start and are harder to overcome later, when the grower wakes up, as he must if he expects from his trees returns worth talking about. Some of the greatest fruit states have laws compelling owners to spray their trees. In certain sections spraying must be done or the authorities will spray the trees and charge the cost in the regular tax levy, or if trees are diseased will even cut them down. This shows how spraying is regarded in some of the most successful fruit-growing localities. It pays to spray every season, all kinds of trees, and in all localities. If you have not done it before, do not hesitate now. Acquire knowledge of the enemies, of the spraying machines, and of the materials to use, and when the proper time comes, *spray*.

Trees are living things, and must be so regarded. If you are to succeed in producing profitable crops, you must approach orchard problems with an open mind. By intelligent spraying you will make sure of having healthy trees, stimulate growth and protect foliage. Proper spraying will prevent scab, blotch, rust, nearly all rotting, damage to fruit by worms; will control scale insects, and almost, if not quite, all the troubles that keep fruit out of the flawless class. It will insure a big crop of full-sized, clean leaves. Foliage is an essential physical part of a tree. To secure good foliage, you must protect the trunk, limbs, twigs and buds of the tree from injury. Spraying does this, and at the same time seems to help growth, especially when lime-sulphur is used. It is certain that trees which are sprayed take on a brighter green, make a better growth, live longer, and produce fruit which is cleaner, better colored and better ripened than trees which are not sprayed. (Probably due to antiseptic action of spray materials.) If done right, spraying can not possibly harm trees, and is almost sure to cause them to live twenty years or more longer than they would if they had not been sprayed.

The first essential in spraying is to find out what to spray *for* —what you want to kill, and how to go about it. There are four classes of enemies that must be fought, with many kinds in each class. You may have none, one, or all four on your trees now—if none, you are likely to get some next month. That is not cheering, but, if you heed the warning, it will help you to add several dollars to the value of the fruit you can harvest from each tree.

There are insects that chew at trees or fruit, like codlin moth larvæ (apple worms) and curculio; insects that suck at trees, like San José scale; parasites that take root on trees or fruit, like bitter rot, blotch, and mildew; and bacteria which attack leaves, bark or wood, like fire blight. Each has to be fought at the right time and with different materials, but the treatments often can be combined so that several enemies may be overcome by the same sprayings.

To give the most and clearest information in the least space,

we have adopted the plan of describing briefly the enemies of each fruit in the chapter given to the fruit, so they may be recognized, and of telling the remedy for each trouble and how to make and use it in the spraying directions and in the formulas immediately following. Here we give general points that must not be overlooked:

Insects that chew are killed by poisons. Arsenate of lead is used universally to control them, and is generally conceded to be the only satisfactory remedy.

Insects that feed by inserting their beak into the bark and sucking juice cannot eat poisons placed on the surface, so they must be gone after with a contact mixture that will kill them when it touches their bodies. In the long search for suitable materials for this purpose, experimenters had great trouble to get mixtures of a chemical composition that would kill insects and yet not destroy or injure trees. The margin is narrow and the greatest care must be used in preparing the remedies, both to get the right proportions of the different materials, *and to combine them right.* A little change in mixing lime-sulphur, for instance, may make all the difference between a solution that is effective and one that is worthless or dangerous.

To control sucking insects, the miscible oils may be used to a considerable extent. Their chief value lies in their ability to clean up quickly bad infestations of scale on apple and pear trees. (They are also useful on shade trees, for several enemies.) But nine-tenths of the time, lime-sulphur solution is unquestionably the best material for all sucking insects on all fruit trees.

Carefully note that some spraying is done on trees when dormant with one kind of lime-sulphur; and when in leaf, with a different mixture, or at a different strength. The scale insects (or any sucking insects) are very hardy and difficult to kill. Strong solutions must be used to do it, and these solutions would kill foliage and tender twigs if applied during the growing period. A solution that will not damage the foliage will hold the insects in check. The solutions must reach every fraction of an inch of surface and should go on with good pressure. A pressure of 100 to 150 pounds to the square inch will insure results that cannot be obtained with lower pressure, and will economize material.

Fungi and parasites are the third class of tree enemies mentioned. These really are plants, of a very low order, which live by attaching themselves to other plants and drawing their food from the living bark, wood, leaves or fruit. Leaf spots and rusts, the rots, etc., are familiar forms of fungi. Toadstools and common mold are also fungi, of a different kind, growing only on *dead* matter, while the fungi which bother trees grow on *living* matter.

Fungi generally increase by dividing their bodies and by growing a fruiting stalk, which finds its way up or out from the root, as a plant stalk grows from the seed, then produces a spore or spores. The spores are thrown off and scattered by wind, birds, etc., and sometimes by fogs. Most fungi live *inside* the

bark, fruit or leaf tissue. To protect your trees and fruit from injury by fungus, the remedy must be applied at the right time—which is just before the spores have made their appearance. This will make it impossible for them to germinate or live after they lodge on bark, foliage or fruit.

If the spores once germinate or start to grow, they commence to destroy the tissues on which they live. Even though you should kill them then, you could not replace the leaf or bark tissue that has been destroyed already. You must coat baby fungi with a mixture that will kill them, and the work is done, for mature fungi "plants" will not live long if not allowed to reproduce. Prevent the injury—you cannot cure it.

While there are almost unnumbered kinds of fungus, the preventive measures are simple. Two or three applications of a standard fungicide mixture at the proper time and in a thorough manner are all that is required. Lime-sulphur solution at the dilute strength, *combined with arsenate of lead*, or self-boiled lime-sulphur, are effective for early sprayings most of the time; but in some instances Bordeaux mixture is still the proper remedy. They should be used in the ways advised in spraying directions.

For diseases of trees, or attacks of bacteria, examples of which are fire blight of pear and apple, and yellows of peach, no material is much of a remedy and spraying is of little use. Trees do not have a circulation, as do animal bodies. It is absolutely impossible to get a remedy dissolved into the sap of trees and to make it circulate to every fiber. The only thing to do is to cut away the affected limb or tree several inches below any sign of the trouble. Fire blight will show by a dark line just how far it has gone, and you must cut below this. Yellows, however, seems to be in the whole tree, and the tree should be removed, root and branch. Watch your orchard, and when you see indications of this class of enemies, get your axe and saw quickly.

In doing this work, have a strong germicide or antiseptic into which you can dip your tools after cutting off each tree or limb. If you do not do this, the tools will carry bacteria, and thus spread the trouble. But do not hesitate to cut. The only time when it pays to try to "doctor up" an affected tree is in the case of a fine old landmark or lawn tree. Here you can wash or most thoroughly spray the whole tree—trunk and twigs and leaves—with a solution of corrosive sublimate or of copper sulfate, with a little chance of checking the spread of the disease so that excessive pruning will not be needed.

There is considerable difference between the different fruits, and varieties in each fruit vary, as to their ability to withstand insects and diseases, and also as to their ability to stand strong spray materials without burning. One kind of fruit, or one variety, will be badly attacked by some trouble, while right beside it will be trees of a different fruit or of the same fruit and a different variety, which will be affected very little or not at all. Thus peach is always more tender than apple, and it will not stand nearly as strong materials.

As an instance of varietal differences, York Imperial apple leaves are always badly infected by cedar rust whenever any spores are near, while the leaves of Greening and Ben Davis trees are little troubled. On the other hand, Ben Davis fruit will be seriously infected, while both the Greening and York Imperial fruit will be clean. In certain sections a particular enemy may be especially bad, and almost entirely unknown in another section. So the differences go. Plum is tougher than peach, but not nearly so tough as cherry, nor cherry as pear. You must adapt your spraying to the kind of tree to be sprayed.

The importance of knowing the class, the life history and the habits of your little enemies can not be over-emphasized. Spraying is of no use unless the proper mixture is applied at the right time, in the right strength, and in the right way. You seldom can kill an adult bug—you can kill only the young at a certain stage of their life, and so prevent the coming of a new generation. The life of insects generally is short and they eat little when matured. Adult enemies will not do much harm, and soon will disappear if they are not allowed to produce young.

Often there are only two to four days during which the spraying can do any good. All the trees have to be gone over then—every leaf and twig and inch of bark. Rainy weather may cut even this short time down to one-half or one-third the time, and you must have men, machines and materials ready to do the work quickly. A great many of the enemies hatch just about the time buds are opening and just when the petals begin to fall from blossoms. Those are spraying times. Some insects hatch two or more broods in a season; so to destroy them requires several sprayings in one summer—always at a certain time, to catch the young at the right period.

Study the enemies. Learn to know them well—to know what they look like, their habits and when to expect them. When you know these things, you can fight them successfully. Merely to "spray," without knowing, will be the poorest of guess-work, with little chance of success. Even when you feel there are no large numbers of enemies in your orchard, spray for insurance. You can protect absolutely a hundred dollars' worth of fruit with two dollars' worth of spraying—and it pays.

Thoroughness is the key to success in spraying. All the bark and both top and bottom of every leaf must be wet. If you miss a branch in the top or center of the trees or the under sides of a few leaves, enough insects may be left to cover the tree again in a week. It is something like the case of the woman who worked all day at killing flies in her home. When night came there was just one pair left, which, in the kindness of her heart, she let live. But, as she sorrowfully said afterward, "Early next morning there were a million."

Put the spray material on with *force*. At least 100 pounds' pressure should be used, while in some cases 150 or 200 pounds is best. Drive it into the cracks and crevices in leaves and bark. Get nozzles close to all the twigs and branches, and use hose rods, wagon towers and high-pressure pumps that will enable you to do the work right.

The question of sprayers is not hard to solve. A few gas sprayers have been made, but compressed-air machines are the most satisfactory by all odds. We have found several makes and sizes on the market to be very good. Some are illustrated here. A man usually develops a liking for some one kind after becoming well acquainted with all, because of differences in type and working. The principal points to consider in buying are these:

An outfit should be of a size suited to your needs, and made so it will work satisfactorily under your condition. For a half-dozen trees a small hand-pump in a bucket will do the work. A knapsack sprayer is a better form of this. The next step up is a sprayer with a tank and pump, mounted on a frame in the form of a wheelbarrow, and worked by either one or two men. Where you have to spray more than fifty trees, it will not pay to go as slow as this kind of machine does the work.

Even for a dozen trees it will pay to have a barrel-pump, to be set on a wagon or sled, and run by two men. Effective work can be done with this, and many orchards containing a couple of thousand trees depend on two or three such outfits, yet it is poor economy to use this type of sprayer for more than a hundred and fifty ten-year-old trees.

Variations of this form of sprayer are to have the pump and the barrel or tank mounted on a frame and two wheels of its own, either as low as possible, to pass over stumps, etc., or as high as a man's head, to aid in getting pressure. The high type is best on land that is nearly level, but the low type is necessary on hillsides, on account of the danger of upsetting. Whether the mounting be on wheels, sled or wagon, the tank barrel or other shape, and made of wood or steel, the pumps horizontal or perpendicular, the handle long or short, red or green, the air pressure is got by working the lever by hand.

Every man who has a hundred and fifty or more ten-year-old trees, or a larger number of younger ones, should get a power sprayer. The advantage of securing the pressure from an engine instead of from man-power are many. The pressure from an engine on the average is about twice as high and more regular than with hand pumps, insuring better work; the engine does not get tired; and two or three nozzle-men can give all their attention to reaching every leaf and twig with the liquid. With a power outfit you can get over the whole orchard during the limited time in which spraying needs to be done—you will not have to start too early and continue too late.

There are many types of power sprayers, some with engines and pumps on skids, to be mounted on a sled or wagon with a tank, but the best are those on low, broad wheels of their own, with a cut-under frame that permits short turning; a steel tank holding about two hundred and fifty gallons, hung no higher than two feet from the ground, and the engine and pump at one end of this, preferably in front. The tank should contain a geared agitator. The pump and all other machinery should be taken apart easily for removing clogging materials or for repairs and cleaning. A tower built over the tank, with a

platform about ten feet from the ground, will help in reaching the high limbs. Light draft is an important consideration, and both weight and wheels influence this.

Pumps and engines with several cylinders are better than those with but one cylinder, although the majority of power sprayers—good ones too—rely on one-cylinder engines and pumps. Whatever the size, from knapsack to six-hundred-gallon, twenty-five-horse-power sprayers, insist on strong, durable construction. Pump valves should be of brass, or better, of bronze, and tanks usually should be of steel. Wood is good, but too heavy. Other passible materials will be corroded by the chemicals in a season or two. Bordeaux is harder on steel than lime, but is used less.

What is known as the central charging system has a pumping and mixing plant, and a dozen or more compression tanks. These tanks are nearly filled with spray mixture, and, after charging, several tanks can be hauled to the orchard, where one is loaded on a light spraying wagon, hose and nozzles attached, and the spraying done from stored-up pressure. This system saves much time in a large orchard. The spraying crew keeps right at work all the time. The cost of installing such a plant is about $2,500, including central engine and pump, and tanks.

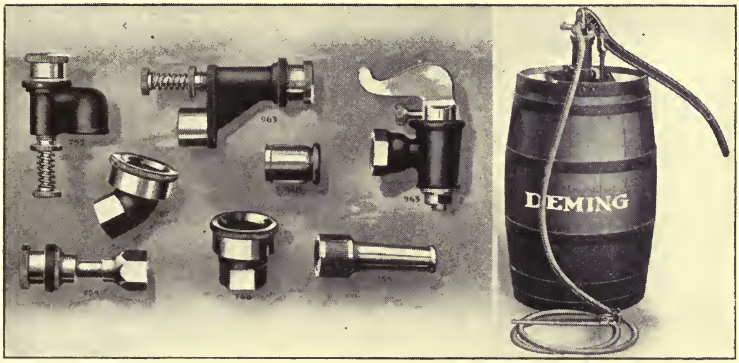
When buying a sprayer of any size, get the catalogues of the makers who advertise in farm and fruit magazines and books. There is a wealth of education in these. By studying the situation in the catalogues and by writing to makers, you can select intelligently that which suits you best. But do not buy a pump that is too small, and do insist on getting one that will do good work at the start and for ten years or more. Better stick to the kinds known to be reliable.

There are many different kinds of nozzles. Your sprayer will be fully equipped with necessary attachments when it comes from the manufacturers, and experience will teach the need of additional nozzles, hose, extensions that may be used for easiest work. Clogging of nozzles is a great trouble. Some nozzles deliver the spray more effectively than others—that is, so it will reach farther and will spread better over leaves and bark. You will need plenty of nozzles, so you can change quickly for a different mixture or on account of accidents.

The directions here tell pretty plainly what mixture to use for each purpose, but you must become familiar with handling the chemicals themselves before you will be able to use materials most quickly, cheaply and efficiently. Beginners always will do well to buy and use *reliable* commercial sprays, at least until they better understand everything about killing "bugs."

Many orchardists who have large numbers of trees depend wholly on some of the excellent prepared mixtures supplied by responsible chemical makers. For less than fifty or a hundred trees, it is often cheaper in any case to buy ready-mixed spray materials than to mix them at home. The great advantage of dependable commercial sprays is that the materials are pure, are properly combined, and that you are given specified direc-

Note the tower on wagon frame, and the long nozzle rod for high limbs.



Types of nozzles and of barrel pump. Have plenty of nozzles.

Six-year orchard. Small picture shows compressor for putting lid on bushel apple boxes.

In proper storage-houses, apples keep well in bulk if rushed to storage when picked.

"Take home" baskets should be given more attention. Face barrels like this.

Low trees are easy to pick from. Picking baskets should have turn-down handles.

Packing-shed in peach orchard. Processed peaches that bring good prices.

Use diagonal pack, and tissue wrapping to deliver apples to consumer in good shape.

tions for applying them for each class of enemies. You do not have to study the "bugs," the spray, and the time to spray.

You could spray for each class of enemy—go over the trees once for each kind—but by combining the different materials properly, you can make two or three or four sprayings a season do all the work. With some one or two or three standard mixtures for the different classes of enemies, as bases, you can add poisons or other materials and strengthen or weaken them, and in this way meet all the conditions.

Suppose, for instance, that you buy or make the standard lime-sulphur mixture. Properly diluted, this will be your dormant San José scale spray; diluted still more, with arsenate of lead added, or made in the self-boiled form (generally best), with the lead, it is the thing for spraying buds and blossoms—the poison killing codlin moth and curculio, the lime-sulphur controlling fungi and sucking insects. Combinations of various kinds can be made to suit the occasions. That is where study and experience count.

Elevated tanks for both water and mixture are great savers of labor and time. With them you can quickly fill sprayer tanks by gravity without pumping or dipping. Mixing can be done both by gravity and by pumps. Run two streams of different materials into one vessel at the same time, with force if possible, and mixing will be thorough. Do the final mixing in spraying-tank. Some of the power outfits are equipped to mix materials with their pumps or with the agitator. The engine will do it more completely and more quickly than it can be done by hand.

Our final word to you on spraying is this: *keep posted.* Spraying knowledge has reached an advanced stage, yet much progress is made every year. A few years ago, when we knew little about spraying, we had to take various roundabout courses to accomplish results. As our understanding of the subject grows more complete, we take many shorts cuts. Many a ten dollars can be cut off the cost of thorough spraying by knowing all about a certain habit of this or that enemy, and by knowing the exact effect of some mixtures on the pests. What we think is a good spray this year, may be replaced by a better one next year. We must keep informed.

The farm and fruit papers and magazines, new fruit books, state and national experiment stations and chemical companies continually are supplying new and valuable information about enemies and about how to overcome them. Be sure to get all the state and government bulletins, and all the books that you can find or can afford to buy. Read them, and make notes of what impresses you as valuable for use in your orchard. One season of this will educate you and enable you to work out a plan by which you can do your work at the least expense and with the greatest results. During the winter is the time to plan the next season's spraying. Go to your trees often. Get a magnifying glass and learn to identify the various scales and insects. When you know the enemies, and watch the trees, all bad infectations can be prevented.

INDEX OF MATERIALS TO USE IN CONTROLLING INSECTS AND FUNGI, AND OF WHEN TO APPLY

REMEDIES ARE NUMBERED IN THE FORMULAS FOLLOWING

The principal insects and fungous diseases seriously affecting each fruit are the following, which are named as nearly as possible in the order of the time they will appear. In isolated communities there may be heavy infestations of some usually unimportant trouble, but it will come under one of the three classes, and can be remedied by the material mentioned as a remedy for others in that same class. If spraying for the enemies named here is done thoroughly, little attention need be paid to some few less serious ones, because they will be disposed of without additional sprayings directed solely at them.

APPLE

Sucking Insects	*Chewing Insects*	*Fungous Diseases*
San José Scale	Codlin Moth	Scab
Oyster Shell and Scruffy Scales	Curculio	Cedar Rust
Plant Lice (Aphides)	Borers	Leaf Spots
	Canker Worms	Cloud and Blotch
	Tent Caterpillars	Bitter Rot

San Jose Scale. Concentrated lime-sulphur solution or miscible oil during the dormant period; that is, from two or three weeks after the leaves fall till the beginning of growth in spring. Mild days during fall, winter or spring should be selected for spraying. Lime-sulphur is almost always the best treatment. During summer the use of self-boiled lime-sulphur, or of diluted lime-sulphur solution with arsenate of lead, will hold scale in check.

Other Scales. Lime-sulphur solution or miscible oils early in spring, followed by soap solution in May and in August, when scale insects hatch and move.

Codlin Moth. First brood appears first about blooming time, second brood three or four weeks later. Use arsenate of lead after blossom petals fall and while calyx is open (a period of about ten days); again, for second brood, three weeks after first treatment.

[NOTE.—The codlin moth treatment should be combined with the second and third sprayings for scab. Use strong lead solution—two to two and one-half pounds of paste to fifty gallons.]

Curculio. Appears about the time for second spraying for codlin moth (third for scab) and is controlled by it. Arsenate of lead in some mixture three weeks after petals fall.

Plant Lice, or Aphides. Some seasons they cause great injury to foliage and fruit. They are sucking insects, and can be controlled by weak soap solutions, or weak solutions of miscible oil, if the application is made as soon as they appear. They increase with wonderful rapidity, and work largely on the under side of leaves, making the leaves curl up. Spraying must be done early or it will be impossible to kill them. Spraying before

buds burst with lime-sulphur solution helps to keep them away.

Canker Worms. There are two distinct species: the spring canker worms and the fall canker worms; both are leaf-eating insects. Use arsenate of lead. The spring worm in nearly all cases will be controlled by the Codlin Moth sprayings. The fall worm is controlled by arsenate of lead in water, applied when insects appear.

Tent Caterpillar. The apple-tree tent caterpillar moths appear usually the first two weeks in July, in northern Atlantic states, and deposit eggs. These eggs hatch in spring, usually about the last of April, and the worms begin constructing nests at once. Spray with arsenate of lead when the worms appear. One thorough spraying will kill them all.

Scab. One of the earliest of fungous diseases to appear. Use diluted lime-sulphur solution combined with arsenate of lead, or self-boiled lime-sulphur with arsenate of lead. Apply first just after cluster buds open and before bloom opens; second spraying, about ten days after blossom petals fall; third spraying, three weeks after second. (The arsenate of lead in the second and third sprayings controls codlin moth, curculio, etc., besides adding to the fungicidal value of the lime-sulphur, and preventing the diluted solution from burning foliage.)

Cedar Rust. Appears about the same time as scab, and spraying dates are about the same. Its injury is most serious on leaves of York Imperial. It also attacks fruit on Ben Davis and other varieties considerably. Cut out all cedar trees in the vicinity. Lime-sulphur and bordeaux are only partly successful in controlling it. The only material that has ever showed over 75 per cent efficiency against cedar rust is Atomic sulphur.

Leaf Spots. These include several different kinds, but, for the purpose of spraying, may be considered as one. They appear about the time of the second spraying for scab. In sections where any one species may severely attack some variety, two or three additional sprayings may be required for control. The first two sprayings are the same as the second and third for scab, and the others should follow at intervals of about three weeks.

Sooty Fungus (Apple Cloud), Fly Speck Fungus, Blotch, etc. These troubles are remedied by the sprayings for scab, etc. Diluted lime-sulphur solution to which is added arsenate of lead, or self-boiled lime-sulphur with arsenate of lead, will do the work. Bordeaux is seldom needed, and never should be used before the fruit has reached the size of hickory nuts.

Bitter Rot. Chiefly a disease of the fruit, but attacks branches of trees also. Bordeaux Mixture is the most effective remedy for this trouble. Lime-sulphur will show only about 50 to 60 per cent efficiency against it. Spray first about July 1, with Bordeaux Mixture with arsenate of lead added; second, repeat in three weeks; third, repeat about the middle of August. In wet seasons a fourth spraying is sometimes needed. The arsenate of lead may be omitted in third and fourth sprayings.

[NOTE.—Do not use Bordeaux on *tender* fruit and leaves—it will surely russet them; use lime-sulphur in proper form instead.]

Blight. This must be cut out quickly, whenever it appears, and tools washed after every few cuts with a strong antiseptic.

ASPARAGUS

Insects	*Fungous Diseases*
Asparagus Beetle	Rust
Rose Chafer	

Asparagus Beetle and Rose Chafer are both chewing insects, and are controlled best by arsenite of zinc. This is best applied in a fungicide (use one and one-half to two pounds in fifty gallons), but never must be used on cutting beds, as it is a deadly poison. If necessary to combat the insects on cutting beds, hellebore may be used if given a week on the plants in which to lose its strength, before the plants are sold.

Rust. Use diluted lime-sulphur solution or self-boiled lime-sulphur; make either only three-fourths as strong as for spraying apple.

[NOTE.—Owing to the spindly nature of asparagus, effective spraying is very hard. This must be fully realized and efforts made in proportion, or results will be only partially successful.]

CHERRY

Sucking Insects	*Chewing Insects*	*Fungous Diseases*
San José Scale	Tent Caterpillar	Brown Rot
Plant Lice	Canker Worms	Leaf Spot
	Curculio	

San Jose Scale. Treat exactly the same as you do on apple.

Plant Lice. Spray when they appear with weak solution of soap or oil.

Tent Caterpillar. Arsenate of lead as directed for same trouble on apple.

Canker Worm. Arsenate of lead when worms appear.

Curculio. Arsenate of lead after bloom is down, and repeat in two weeks.

Brown Rot. Use diluted lime-sulphur solution with arsenate of lead, or self-boiled lime-sulphur with arsenate of lead. First spraying must be while leaves are unfolding. A second and third spraying should follow at intervals of two or three weeks.

Leaf Spot, etc., will be covered by spraying for brown rot.

[NOTE.—Arsenate of lead must not be used within a month of ripening time, owing to danger of poisoning those who eat the fruit. Use hellebore if poisons are needed later than this.]

CURRANT AND GOOSEBERRY

These fruits are subject to attacks from a few of the same enemies that attack fruit trees, and the remedies are the same in each case, both in material and time to apply. Use combinations of lime-sulphur in proper form, with arsenate of lead, or soap or miscible oil solutions in their places.

GRAPE

Sucking Insects	*Chewing Insects*	*Fungous Diseases*
Leaf Hopper	Blue Beetle	Black Rot
	Berry Moth	Anthracnose
	Curculio	Mildews
	Roootworm	

Leaf Hopper. Must be sprayed before young can fly, with solutions of soap or oil.

Blue Beetle, Berry Moth Larva, Rootworm, and **Curculio Larva** are chewing insects, and are controlled by arsenate of lead. First spraying for them should be before blossoms come; second spraying after fruit sets, and third in July. Combine the lead with a fungicide whenever possible.

Black Rot. Attacks leaves first, then berries. Bordeaux Mixture is the most effective remedy in most cases. Lime-sulphur in proper form, combined with arsenate of lead, should be used oftener than it has been in the past. Spray first when buds begin to open; second, just after new shoots appear, before blossoms open; third and additional spraying should take place every ten days or two weeks until five or six applications have been made. If the disease shows near ripening time, use ammoniacal copper carbonate, because it will not russet the fruit.

Anthracnose. Difficult to control. Spraying material and dates correspond to those for Black Rot, except that the work should be done even more thoroughly.

Mildews. Materials and dates for spraying the same as for Black Rot. Two or three sprayings will control mildews; first one before blossoms open; second, after fruit has set; and third, ten to fourteen days later.

PEAR

The sucking insects, the chewing insects and the fungous diseases which attack pear are practically the same as those that attack apple, and are controlled by the same treatment. Pear, therefore, need to be sprayed while dormant with concentrated lime-sulphur for controlling scales, when buds open and when blossoms open with combined insecticide and fungicide, and later, sometimes, with Bordeaux for rot. Pear foliage is tough, and will stand strong sprays.

PEACH

Sucking Insects	*Chewing Insects*	*Fungous Diseases*
San José Scale	Curculio	Leaf Curl
Lecanium Scale		Scab
Aphis		Brown Rot

San Jose Scale. Kill by spraying in dormant period with concentrated lime-sulphur solution. Hold in check during summer with self-boiled lime-sulphur or diluted lime-sulphur solution to which is added arsenate of lead.

[NOTE.—Peach foliage is more tender than apple. All foliage sprays for peach should be only from one-half to three-fourths as strong as for the corresponding trouble on apple. This is very important, and must not be overlooked.]

Lecanium Scale. Use miscible oil in spring, just before buds open. Caution is necessary in the use of oils on peach. They will burn foliage badly if the least bit too strong.

Aphis. Use soap solution when noticed.

Curculio. Appears about the time blossom shucks are shedding. Spray with arsenate of lead in some combination, and again in four or five weeks if there seems to be need of it.

[NOTE.—Peach foliage is tender, and the arsenate of lead must be weaker than for apple spraying. Using one and one-half pounds of paste to fifty gallons of other mixture.]

Leaf Curl. Is controlled by dormant lime-sulphur spray, applied just before buds begin to swell. This is the same treatment given San José Scale in spring.

Scab. Self-boiled lime-sulphur and arsenate of lead, applied about two weeks after the blossom shucks go down, and again two weeks after that.

Brown Rot. Controlled by the treatment given for scab. May require an earlier and a later spraying with a fungicide. Be sure to cover the twigs and fruit all over, especially with the later sprayings.

PLUM

The principal enemies of plum are the same as those of peach, and must be treated the same for successful control. Plum foliage is more tender than apple foliage, but not quite so tender as peach, and the benefit of slightly stronger spray material than peach will stand can be utilized if needed.

QUINCE

Quince enemies, with treatment for them, are exactly the same as for apple or cherry. The foliage is relatively tough, and the enemies are easily overcome by the proper measures. Quince will be attacked more than apple, however, if not sprayed, therefore we can say that spraying is more important with quince than with apple or pear.

STRAWBERRY, RASPBERRY, TOMATO AND OTHER SMALL FRUITS

Many of the enemies that attack the large fruits also attack these. Rusts and blights, however, are especially bad on some small-fruit foliage and canes. For control of these there is nothing better than self-boiled lime-sulphur. If chewing insects are present, as they nearly always are to some extent, the addition of arsenate of lead to the fungicide will kill them. The time of application of the fungicide is just before leaves come out, and again when leaves are half-grown. A third application can be made when canes are six inches high, but none must ever go on mature canes of raspberry and blackberry, particularly. The time to apply poison for insects is when they are first noticed, or about the time petals fall, and again in two or three weeks. On tomatoes, lime-sulphur may be sprayed on

the fruit from the time it has set until six weeks later, if needed for anthracnose.

OUTSIDE INFECTION

Spray brush, trees and plants of all kinds near your fruit trees. Only by doing this can you completely protect the fruit and trees from enemies. Ornamentals, windbreaks and hedges often are nurseries for large crops of insects and fungi. Make it a rule to remove useless trees about an orchard, and spray all that remain with a combined fungicide and poison a couple of times each season. The best times will likely be, for the first spraying while dormant; second, when leaves are half-grown. Cut down all red cedar trees, anyhow.

FORMULAS

Here follow directions for making every kind of spray material that will be needed. The process of making them requires some equipment, knowledge and skill. Where large amounts are to be used, and where the pure materials can be bought at wholesale prices, it is undoubtedly cheaper to mix the chemicals at home than to buy prepared mixtures.

If you know how to boil or otherwise combine the chemicals so they shall make a mixture of just the right strength, and how to dilute properly for each condition or enemy, you are safe in making your own spraying materials. But if you do not know of these things, if there is a doubt in your mind about any of the amounts, or of the processes of manufacture, better by far buy a well-known brand of commercial spray material. A great many orchardists who know how to mix the elements prefer to buy their sprays ready-made because of the greater certainty of getting pure materials and correct, uniform manufacture and strength.

The "strength" of many spraying mixtures and solutions depends so often more on the mixing process than on the amounts of the different materials used that skill in the manufacturing process may mean many dollars to the user. The way the various chemicals combine, the bi-products formed and changes made by their combining, the temperatures at which they are mixed and tested, all have much influence on the final product. We cannot insist too strongly on good spraying mixtures.

FUNGICIDES

1. **Self-boiled Lime-Sulphur.** Eight pounds of fresh lump lime (quicklime), eight pounds of sulphur (flour, flowers, or powder), water 50 gallons.

Put the lime in a vessel and pour on enough water to cover it. Add the sulphur, either finely sifted or made into a thick paste with water, as soon as the lime begins to slake and boil. Different limes vary in heat-producing power. Good stone

lime gets very hot at once; partly slaked or slow lime will not heat up so quickly nor so much.

Ordinarily the mixture should boil about ten minutes; care must be taken lest the boiling goes too far. During this time the mixture should be stirred constantly. At the end of the ten minutes, or as soon as all the lime is slaked, add cold water to the mixture and stop further boiling. If the mixture is allowed to remain hot ten or fifteen minutes after slaking is completed, the sulphur will combine with the lime and form sulphides which will burn foliage, particularly peach leaves.

This solution can be left standing for a year, if desired, or is ready to use at once. To the mixture, made as directed here, add enough water to make fifty gallons; then strain, so it will work through pumps and nozzles, and apply.

Self-boiled lime-sulphur is one of the best mixtures we have for scab, rust, some rots and many similar enemies. It is very effective as a summer spray to hold the scales in check until they can be cleaned up with the stronger fall and spring spray. It forms one of the best bases to which poison can be added for killing chewing insects.

2. Dilute Lime-Sulphur Solution. The regular concentrated lime-sulphur (stock solution) mixture (formula 7), either home-boiled or commercial, can be diluted in proportions of one and one-half gallons of mixture to fifty gallons of water, *and to this two pounds of arsenate of lead added*, to be used in place of the self-boiled lime-sulphur. Some authorities recommend a hydrometer to test the specific gravity of the lime-sulphur mixture, but this test is unreliable and misleading unless all conditions are just right. This solution (for foliage spraying) should test 1.1015 to 1.01 specific gravity. *Never neglect to include the lead when diluting the No. 7 solution for summer work.* Lead is needed in the mixture to prevent burning foliage.

3. Dilute Lime-Sulphur Solution. Commercial or home-boiled concentrated lime-sulphur solution, (7), still more dilute, with about one gallon mixture in fifty to sixty gallons of water, and with the lead added, is useful on the tenderest kinds of foliage, which the stronger solutions will burn. The proper strength of this mixture (home-boiled) will test 1.005 specific gravity.

[NOTE.—Hydrometer tests of commercial solutions are not to be depended on. Follow directions given by the makers to get proper strength.]

4. Bordeaux Mixture. There are three strengths of Bordeaux Mixture, called standard Bordeaux, weak Bordeaux and strong Bordeaux. Standard Bordeaux contains three pounds of copper-sulfate (blue vitriol or bluestone), four pounds of fresh stone lime (quicklime), and fifty gallons of water. Weak Bordeaux Mixture contains one and one-half pounds of copper-sulfate, three pounds of lime and fifty gallons of water. Strong Bordeaux contains five pounds copper-sulfate, five pounds of lime and fifty gallons of water.

Put the copper-sulfate into a burlap bag; to dissolve it, hang this overnight just beneath the surface of a vessel half full of water. It also may be dissolved in boiling water, using at least

a quart of water to the pound of bluestone. Slake the lime in enough water to prevent it from burning. When you have a smooth milk of lime, add enough water to make twenty-five gallons. Do the same with the few gallons of copper-sulphur solution, and pour the diluted solutions together. The solutions never must be mixed with concentrated, although diluting one before joining them will avoid the trouble caused, if care is taken to keep the proportions right.

Air-slaked lime should not be used in making Bordeaux Mixture. It is best to slake lime and keep it in the form of paste or putty. In this condition it can be kept indefinitely if covered with an inch or two of water. Use three times as much of this lime paste, by weight, as of fresh stone lime. A good plan is to cover the bottom of a flat trough a couple of inches deep with lime and work this into a putty. You can calculate how much of this you need to make the proper proportions, and then take a brick of the required size from the trough, as needed. The lime also can be dissolved in water and kept—one pound of lime to a gallon of water. Add water to replace evaporation.

The copper-sulphate can be dissolved in the same way—one pound to the gallon—and kept until spraying time. To make the spraying mixture, in any strength desired, simply use one gallon of each of these solutions instead of a pound of the respective materials. But always dilute before putting the stock solutions together. After it is made, Bordeaux will not keep for any length of time. No more should be mixed than will be used each day. If stock solutions are prepared, Bordeaux can be mixed on short notice. With good lime there will be no danger of burning the foliage at the strengths given here when this Bordeaux is used on the different kinds of trees according to directions.

Should there be any doubt, you can test the strength, or rather test for free acid, by holding a clean, bright knife-blade in the Bordeaux mixture for about a minute. If the blade becomes coated with copper, more lime must be added. Another test is to pour a small quantity of the Bordeaux into a vessel and blow your breath on it. If it is made properly a thin white film (of calcium carbonate) will form on the surface. If the breath will not produce this, add more lime.

5. Ammoniacal Copper Carbonate. Five ounces of copper carbonate, three pints of ammonia which tests 26° Baume, fifty gallons of water.

Dilute the ammonia with five or six quarts of water. Make a paste, with water, of the copper carbonate. Pour the ammonia solution over the paste, using just enough to dissolve it. Do not use more than is needed for this, but, if any carbonate remains undissolved after standing a few minutes, add a little more of the ammonia solution. This mixture may be kept without spoiling. For the working solution add water to make fifty gallons. This is clear blue mixture that will not stain ripe fruit. It should either be sprayed on before picking or the fruit dipped in it as soon as picked, then rushed into storage. It can be used where Bordeaux will russet fruit.

INSECTICIDES FOR CHEWING INSECTS

6. Arsenate of Lead. This poison can be bought in the form of a stiff, white paste, ready to use by diluting one to three pounds of this paste with fifty gallons of water. The paste usually comes in kegs or cans, and nearly every one will find it the best form to buy. Care must be taken that this paste does not dry out. It will not do this if the surface is kept covered with an inch or two of water.

The home-mixed poison is made as follows, but, though it is possible to make it cost a little less than the commercial paste, home manufacture is seldom advisable. Four ounces of arsenate of soda, eleven ounces of acetate of lead and eighteen gallons of water are the materials. Dissolve the arsenate of soda in two quarts of water, in a wooden vessel. Then dissolve the acetate of lead in four quarts of water in another wooden vessel, and when this process is finished pour the two solutions into the required amount of water in the spraying tank.

This spray will be milk-white. It is the most efficient remedy for chewing insects, and it may be added to the lime-sulphur, Bordeaux or other spray. In doing this, if you have dissolved the foregoing amounts in the six quarts of water, add them separately to fifteen gallons of the other mixture—larger and smaller amounts in the same proportion; or, mix two pounds of the commercial paste in fifty gallons.

INSECTICIDES FOR SUCKING INSECTS

7. Standard Lime-Sulphur Mixture. Lime-sulphur mixtures are made and sold by chemical companies. When prepared by reliable people, they are recommended, and will give the very best of satisfaction. Directions for diluting and using each will accompany the solution. Generally about one gallon of the concentrated commercial solution to eight gallons of water will be what is required for a dormant spray. As noted before, there are great differences in the value of different lime-sulphur solutions that are due to differences in *process* of manufacture, and not to varying amounts of lime or of sulphur. It is a chemical composition of the final product, a chemical fusing of the elements, that makes the differences more than anything else. If you haven't many trees, it is always cheaper and less bother to buy prepared lime-sulphur, and many times it is so with large orchards to spray. Unless you prepare your own solution very carefully, you will not have nearly so good material as that you can buy.

For the home-boiled solution, use fifteen pounds of fresh stone lime, fifteen pounds of sulphur and fifty gallons of water. Slake the lime in an iron kettle in which the mixture is to be boiled, using enough water to cover the lime. (Don't use copper kettle.) Better make a paste of the sulphur before you put it in, or at least sift it thoroughly. Stir while adding the sulphur, which should go in while the lime is slaking, then add ten or

fifteen gallons of water and boil this mixture for about an hour, or until the mixture becomes a deep orange-red or a deep green. It may take on either of these colors; lime never seems to act twice alike in this respect. Add enough water to bring the volume of the mixture up to fifty gallons and it is ready to use. This solution should test about 1.04 specific gravity.

Both the commercial and the home-made mixture, at the strength directed here, are to be used only on dormant trees, and must not be used on foliage. At this strength it will burn nearly all the leaves off if it is applied after the buds open, but it is no stronger than needed for winter work. Properly diluted and with arsenate of lead added, lime-sulphur is a most valuable summer spray. See formulas Numbers 1, 2 and 3 (self-boiled lime-sulphur and diluted lime-sulphur solutions must be added to prevent burning foliage).

8. Kerosene Emulsion. Make a stock solution with one-half pound of hard soap, one gallon of hot water (soft) and two gallons of kerosene. Chip the soap fine and dissolve it in hot water. Take the vessel away from the stove and from any fire and add the kerosene while the water is still boiling hot. Immediately churn this thoroughly, or better, pump it violently back into the vessel until it forms a creamy emulsion. When only a small quantity of the spray is wanted, sour milk can be substituted for soap and water.

For various purposes you must have various strengths of kerosene emulsion. To dilute for an eight per cent solution, use one gallon of this concentrated mixture in seven gallons of water; to make a ten per cent emulsion, use one gallon with five gallons of water; to make a four per cent emulsion, use one gallon with fifteen gallons of water. The four per cent emulsion can be used without damage on the tenderest foliage, while the ten per cent emulsion will do good work when trees are dormant.

9. Soluble or Miscible Oils. Chemical manufacturers prepare brands of oil so treated that they fuse readily with cold water. They make efficient and useful sprays, but must be used with caution. When they are too strong, they cause serious injury to plants or trees. In winter, for San José Scale, they do excellent work; and in summer, for various enemies requiring a spray of this character, they are many times advisable. It is best to get information about the strength at which to spray from the maker of the oil you use, but for the winter spray a strength of one part oil in fifteen parts water almost always will be right.

10. Soap Solutions. These make a valuable spray for holding in check San José and other scales during the summer, and for various other sucking insects. One pound of hard soap in four gallons of water, or one pound of whale oil soap in five gallons of water, is the right strength for dormant trees. In any case, dissolve the soap in about one gallon of hot, soft water, then add the remainder of water cold, stirring hard.

11. Tobacco. Can be obtained in several forms—as a liquid, a powder, or in stems, to be used according to conditons. The essential poison of tobacco (sulphate of nicotine) is ex-

tracted and appears on the market in several forms. "Black Leaf," "Nicofume," and "Tobacine," can be bought and made into sprays for orchard insects, such as woolly aphis, green aphis, and some of the other bugs which have to be killed by contact. The sulphate of nicotine can be bought pure and mixed into spray material, also. A tobacco decoction can be made by steeping one pound of tobacco leaves or stems in two gallons of water for a few days; or by boiling a quantity of tobacco about one-half hour in enough water to cover it, then dilute with water to make a volume of two gallons for each pound of tobacco used.

COMBINED INSEGTICIDES AND FUNGICIDES

12. Bordeaux Mixture and Arsenate of Lead. Mix two pounds of arsenate of lead with fifty gallons standard Bordeaux Mixture. First dissolve the arsenate as directed before. The sticky qualities of this new mixture will keep the Bordeaux on the tree longer than it would remain otherwise. This is a very good spray and does not cost much.

13. Lime-sulphur and Arsenate of Lead. Mix two pounds of arsenate of lead with fifty gallons of self-boiled lime-sulphur or of concentrated lime-sulphur solution diluted, one and a half gallons to fifty gallons of water (arsenate of lead always must be added to diluted standard lime-sulphur solutions).

RABBITS, MICE AND BORERS

Borers attack nearly all kinds of fruit trees, but do most damage to apple and peach trees. They fairly revel in locust and many other forest trees, and some kinds of bushes harbor them. There are three or more kinds. One has a flat, black head; another a round, black head. These two work in apple trees. They are supposed to live on the inner layer of bark of the trunk, near the surface of the ground, but their tunnels sometimes extend entirely through the tree and for more than a foot up and down.

Peach borers are soft, yellowish worms with a reddish brown head. They do not usually go so deep into the wood as do apple borers, but live just under the bark. Either kind can be located by the sawdust made, and in peach, etc., by gum, which comes from the hole where borers entered. Peach borers hatch in June or July from eggs laid on the trunks of trees. The young either eat their way in where they were hatched, or drop to the ground and enter the trunk at the surface of the soil. This kind stays in the trunk one year only, but the other two kinds will remain in from one to three years, growing bigger and eating larger tunnels all the time.

Go over *all* your trees, but particularly those younger than eight years, every March and October. You can locate the borers by their sawdust, by a blackened spot in the bark, or by the gum coming from their holes. Cut around the hole a little with a sharp knife, and if you do not find the worms

right away, run a wire up or down the hole and mash them. There will be from one to six in each infected tree. For many trees, equip yourself with a machine oiler, and inject carbon-bisulfide solution into the holes, then close them with grafting-wax or soft clay.

To prevent borers from entering any kind of trees, apply to the trunks, about the middle of June, the Whale Oil Soap solution, No. 18, or Lime-Sulfur Solution, No. 15. Painting the lower eighteen inches of trunks with pure white lead and *raw* linseed oil will help, too. Apple borers, however, sometimes enter three or four feet from the ground, but these worms never get very big. Salt and ashes, or tobacco dust, in a layer a couple of inches deep about the base of the tree, will kill the worms that drop off and try to reach the trunk.

Mice girdle trees by gnawing the bark off under the snow (and sometimes during summer when grass grows or lies close to the trunk), particularly when there is a crust that stays on well into late winter. To prevent this damage, *be sure* to draw all weeds or mulch of any kind back at least a foot from the tree in August or September, and *never* allow any mulch or grass closer than six inches to the trunk. The earth in this open space should be heaped from three inches to a foot high about the tree. Mice will not cross this open space. Tramping the snow about each tree before the mice begin working also is a good plan.

Rabbits girdle trees above the snow, and usually do it late in the spring, after the snow has been on the ground a long time. Painting trunks with pure white lead and *raw* linseed oil, as for borers, helps to prevent both mice and rabbits from chewing the bark. Perfect protection is given by wooden veneers on the market, made especially for wrapping trunks of small trees. They cost about 75 cents a hundred. Strips of tar paper, of wire screen or of wire cloth, cut five inches wide and two feet long, then wrapped around a broom handle, so as to make long, open-sided tubes that will spring around the trunk are cheaper and very practical for this purpose.

The Lime-Sulfur solution many times will turn rabbits away, and a mixture of blood and ashes will do this nearly every time. By all means hunt down the rabbits. The boys can set traps that will clean them out pretty well in one winter, and you can form the habit of having a gun with you as you work among your trees. You will be able to send many a bunny to the Happy Hunting Grounds with it, and besides, you will have lots of chances to shoot hawks, foxes and other pests. Bridge-graft trees that have been girdled or partly girdled. This operation can be done for twenty-five cents a tree, and any good orchard tree in normal condition is worth from $5 to $100. Cut whips of last year's growth and bevel the ends so they will lie flat against the bark when the middle is bowed out a little. Then slit the bark above and below the wound, as is done in budding, and slip these beveled ends in against the inner layer of bark. Cover this joint, and whole wound if possible, with grafting-wax. That is all there

is to it. The tree will live and the bark will grow over the wounds.

SUMMARY

Spraying is a vital necessity if money is to be made from fruit. It doesn't pay to doubt this, and it doesn't pay to miss one season, even if enemies are not visible.

Spraying has an invigorating effect on trees, besides controlling enemies.

Knowledge of what to spray for, what mixtures to use and when to apply is a necessity before spraying can be made effective.

There are three classes of enemies spraying will control—chewing insects, sucking insects and fungi. Each class requires a different remedy, but the remedies can be combined most of the time.

Spraying during the dormant period is distinctly different from spraying on foliage. Materials several times as strong can be used and are needed to control the scales.

On account of life habits of enemies, often only two to four days are available for any one spraying and the work must be done then.

Put the material on with force and cover every inch of bark and leaf.

Get a sprayer that is big enough, that will give 100 to 250 pounds air-pressure, that is adapted to your land and trees, and that is durable. Get a power outfit, if possible, for it does better work than a hand pump can.

The spraying program ordinarily resolves itself into two, three or four applications—one while trees are dormant, with lime-sulphur solution, and the others on blossoms and fruit with self-boiled lime-sulphur, or diluted lime-sulphur, with arsenate of lead added, or maybe with bordeaux and lead. All applications must be guided by careful study.

The differences in spraying mixtures is one of chemical combining of the materials, as well as of differences in quantity of each material used. Be sure you get the right mixture.

Borers will attack fruit trees in spite of all we can do and will kill many trees if left alone.

Trees must be gone over once each year, and should be gone over each April and August.

Spraying and painting with lime-sulphur sediment will help in keeping down the numbers of borers.

Keep trash and mulches at least six inches away from tree trunks, and tramp snow about trees in late winter, to prevent mice damage.

Always bridge-graft trees that have been girdled.

Miscellaneous

ORCHARD RECORDS

When you set out an orchard *always* make a chart of the arrangement, giving a place and a number to each tree, then record the numbers, variety and other data in a book. If you fail to do this, you will know how good a forgetter you are when you try to remember where you planted each kind. The information will be useful in a dozen ways. *Take our word that it is worth while, and keep the records accurately and completely.*

To label each tree helps this plan and has other advantages. One of the best ways is to cut heavy zinc into strips about ten inches long, two inches wide at one end and coming to a point at the other. Put these in vinegar for a few hours to corrode them; when dry you can write on them with ink or with an ordinary indelible lead pencil and the marks will stay on for twenty years. Twist the little end of the tag loosely about a limb, and let it hang down. Put on this tag the variety name, the number, possibly the date planted, the number of bushels harvested each year, date of blooming, and other useful data. As the limb grows, loosen the loop a little, or remove the tag to a smaller limb. This helps greatly in the successful handling of an orchard.

CLIMBING CUTWORMS

Those little pests live in the soil and crawl up young trees at night. They destroy the tender buds. The remedy is to put a wrapping of cotton around the trunk of the tree a foot or so from the ground; or better, build a "fence" of tarred paper about the base of the tree. This should be about six inches high, and should go an inch into the ground. Poisoned bran mush at the base of trees is effective also.

GRAFTING

Trees which have proved untrue to name or of worthless varieties should be top-worked with desirable kinds. This is done by grafting eighteen or twenty scions on suitable limbs, just as the bark first loosens in the spring. *Be sure* that the cuttings you use come from the best trees of the best kinds. Wild trees and seedlings about farms can be grafted likewise, as can those good kinds which require cross-pollination. Use good grafting wax, cut scions carefully, and put them in right, and grafts will grow.

Bridge-grafting is explained in the talk on mice damage. It has other uses, as with a tree which has been skinned badly from any cause, a bad split that cannot be repaired by bolting, etc. Try to get at least five or six of the bridges to growing. Cover with grafting-wax the places of insertion and at least the raw edges of bark. It is well to cover the whole surface bared if you can get enough wax.

SPLIT FORKS

Should a tree split, draw the sections together with a rope and pulleys, bore a hole through them and bolt them together. This can be done by using one long bolt, or by using two short ones with rings for heads, and connecting them with a wire or chain. Some growers do not bore holes, but use screws with ring heads. We have seen trees that had a complete system of such supports, all the wires (from each limb) coming together in the center of the head, on a strong ring. *Do not* put a wire or chain around the limbs. It is possible to connect two cross-growing limbs, or one leading toward an opposite fork, so they will unite and form a natural brace.

WINDBREAKS FOR ORCHARDS

A windbreak will protect fruit trees from cold. In case of late spring frost this is done by deflecting up over the trees the downward flowing frosty air. The windbreak must not be thick enough to produce a dead air space in its lee, as such a condition will *cause* frosted blossoms every time. The break must let some of the air through to keep up the motion through the orchard.

With the more tender trees like peaches and plums, a windbreak is of the greatest value, protecting the tender twigs and buds from the most penetrating cold in times of high wind in midwinter. In the summer and fall, half the fruit on heavily loaded trees sometimes will be blown off if not protected by a windbreak; but if protected the normal number of drops will be diminished by at least half, while the damage from storms will be largely eliminated.

Spraying and picking in unprotected orchards often have to be stopped on windy days. Here a windbreak would enable the operators to put the liquid where it is needed or enable pickers to go ahead with their work. A windbreak will retain snow and leaves and so prevent deep frosting and excessive soil evaporation; will lessen breaking of trees and twigs under loads of ice; will enable trees to grow straighter; will protect blossoms from severe winds and so help pollination; and in some cases will hasten the ripening of fruit.

Windbreaks will harbor insects to a certain extent, but not if they are sprayed. If they are not planted far enough from the outside rows of fruit trees they will rob them of plant food. Plant the break at least forty feet from the nearest fruit trees. Some advise that eighty or one hundred feet be left here, and claim that the space will be well used.

Norway spruce, Scotch and Austrian pines and the arborvitæ make the best evergreen windbreak. California privet, Lombardy poplars and maples made good deciduous windbreaks. In some places it is desirable to have the break thick from the ground up; in others it should be open at the bottom, and thicker on a level with the foliage of the fruit trees.

The universal method of packing peaches for shipment, in the East.

Ray peaches thrive under many different conditions.

Grapes may be staked the first three years. After that trellises are better.

Kind of cherries that bring profits. Picture slightly reduced.

A home bed of strawberries adds wonderfully to home's attractions in June.

Glimpse of a commercial vineyard of 300 acres. Note cultivation, training, etc.

How to train grape-vines, at a home. Note bagging in upper right-hand corner.

A fine quince tree. Note method of training, perfect foliage and crop of fruit.

The lay of your land will tell you where to plant the break, and will determine its value. There are few orchards in which a break will not benefit the fruit and trees, besides enhancing the beauty of the place.

WHEN TREES WILL NOT BEAR

Here and there throughout the country are many fruit trees of bearing age which never have produced a single fruit, or at most a few imperfect ones. Everything that has been said about the well-being of fruit trees is an answer to the question, "How can we make these trees bear?"

First look to the condition of the soil. It may lack moisture, or may be too wet. There may be rock or hard-pan close to the surface, preventing root expansion. The soil may lack some or all the plant-food elements, may lack dead vegetable matter, friendly bacteria, or require a general loosening up to a depth of four or five feet.

Explode a charge of dynamite under each tree, and three or four others a few feet away. Mulch the surface with a thick covering of vegetable matter, or by keeping a couple inches of dust under the tree. Feed with commercial fertilizer.

The tree may be growing too fast. In that case reduce the amount of nitrogen. It may be necessary also to reduce the amount of moisture, but this should be avoided, unless there is a decided excess of water, which should be drained away.

Your trees may lack cross-pollination. This is a frequent cause of non-bearing. The remedy is to plant other kinds near-by (see planting section), or top-work bearing trees with one or two branches of other kinds, and the blossoms on these will fertilize those on the rest of the tree. See that trees harbor no scale nor other enemies.

Girdling sometimes is resorted to with success, as is also notching deeply below fruit spurs. The method of girdling is to press a heavy knife into the bark, making in this way a cut entirely around the tree. This will not kill the tree. Other practices are to take an eighteen-inch strip of bark from the trunk a third or a fourth of the way around the tree; to twist a wire tightly around the main limb or around the trunk; or to prune the roots. This last is done by plowing deeply or digging a ditch partly around the tree. More trees fail to bear from lacking roots than from having too many roots.

These methods, although sometimes to be advised, seldom are used by practised orchardists. It is much better to produce bearing by handling the soil, supplying proper food, and by proper cutting back. Bearing can be forced just as surely by these methods, and at the same time the trees will receive what they need in other ways. The good effects will thus be permanent, instead of lasting only two or three years. In general, winter or spring pruning is conducive to growth, while summer pruning leads to bearing. If a tree has not been kept pruned, shaping the head and cutting back will aid in making it bear.

Special Things Needed by Each Fruit

THE foregoing part of this book explains those fundamental things which all trees require. Here following are details of the few special needs in which fruits differ. Do not attempt to be guided only by what is said here, in caring for your orchard, but go back through the soil-handling, planting, pruning and spraying chapters, and apply the suggestions given there in connection with what you get here.

APPLE

Almost any soil will do for apples, but they succeed best on clay loam. The subsoil should be no closer than four feet, if you can get a soil of this kind. Many fine orchards, however, are growing on land where the hard-pan is only eighteen or twenty inches from the surface. Put your trees in the best land you can get, but plant anyhow if your best land is not the most favorable. A slope is better than a level, and the finest apples always grow on high land. Read the chapters on Frost, on Moisture Keeping and on Cultivation. In them you will find much information about the best location for apples.

In all sections north of Delaware and Kentucky, spring planting is best; but fall planting is successful, especially in the South, if it is done at the right time. Trees for fall planting should be ripened early in the nursery, and then planted at once (there is only a week or two in the fall when planting should be done), so they will grow a little before winter comes. This is to give the roots a chance to get moisture with which to replace winter evaporation, and to develop new roots during winter. But in the North, under average conditions, the losses of fall-planted trees will exceed those of trees planted in the spring. Proper spring planting is always successful when done early enough. It is better to get the trees during November and December, heel them in, covering tops and all with dirt, and then plant them the first day the ground is thawed. Heap up dirt about trees twelve inches or more when planted very early.

One-year trees almost always are best. There are many reasons, but two are enough to prove this. One-year trees can be pruned and headed the way you want them. This training they are not likely to get in the nursery during the second year, and that is the time when it must be done. And one-year trees will be larger at the end of four years than will either two- or three-year nursery trees planted in the orchard at the same time.

Before you plant, read again all the entire matter on subsoiling and planting. Dig tree holes with dynamite, if possible. This produces great results. Watch your trees carefully for the first two years and prune them three times each season during this time. Take especial pains to guard against mice and rabbits. Bridge-graft any trees that have been girdled. Never

let three-year-old trees bear more than twenty apples, four-year-old trees more than fifty, or five-year-old more than one hundred. After five years, thin at the regular rate.

Pay attention to securing pollination of your apples. A few varieties may have the power of fertilizing their own blossoms, but the larger number of kinds do not. Baldwin generally is known as a kind that needs little outside help, yet in many experiments where the bees and winds were prevented from carrying pollen from other trees, a thousand Baldwin blossoms would set only a half-dozen gnarly little apples.

By far the greatest trouble due to insufficient pollination is not in the total failure to set fruit, but in the production of knotty and crooked fruit. Freezing will cause apples to grow crooked, but, in nine cases out of ten, they grow that way because the blossoms, while fertilized enough to start the fruit, were not fertilized enough to give it vigor and vitality. The individual fruits were cripples from the beginning. Therefore, provide plenty of chances for cross-fertilizing in your orchards, and do not depend upon trees of the same variety fertilizing each other. See that each tree in the orchard has three or more trees of one or more other kinds within a hundred and fifty feet.

Care must be taken, also, to see that the different kinds in the same section of the orchard bloom at the same time. We know of one big orchard in which there are only two varieties. One is through blooming before the other begins, so no benefit is derived from having the two kinds together.

Two classes are enough into which to divide varieties according to blooming habits. In both the early and late classes the varieties will overlap each other sufficiently. But an early bloomer and a late one could not help one another. Gideon, Gravenstein, Early Ripe, Smokehouse, Stark, Arkansas Black, Benoni, Chenango, McIntosh, Maiden's Blush, Duchess, M. B. Twig, Baldwin, King, Fallawater and others bloom early. Wagner, Yellow Transparent, Spitzenburg, the Greenings, Stayman's Winesap, Winesap, Gano, Williams' Early Red, York Imperial, Rome Beauty, Ben Davis, Hubbardston, Jonathan, Spy, Wealthy, Delicious, Missouri Pippin, etc., bloom comparatively late.

These statements are based on observations in New York. They might not be entirely correct in other localities. Watch the trees in your neighborhood and make notes of when they bloom. If you find your bearing orchard is suffering from a lack of cross pollenization, start at once and top-work some of the trees with other good varieties. In about three years you can expect blossoms on these grafts or buds. When you plant now, see that this trouble is avoided.

As to varieties—it depends on the elevation, the latitude, the climate generally, the time of ripening desired, and the purpose for which apples are wanted. Still the list is not very large. Probably twenty-five varieties cover the good ones for all conditions found between Florida and Ontario.

In the Piedmont and Blue Ridge sections and the Delaware

Peninsula, Winesap, Stayman's Winesap, Yellow Transparent, Williams' Early Red, Grimes Golden, York Imperial, Rome Beauty, Wealthy, Red Astrachan and Yellow Newton are the kinds to plant. The first five of these are the cream of the list for sections south of the Maryland line. In southern Pennsylvania, West Virginia and similar localities all these kinds do well, particularly Stayman, Rome Beauty and Grimes Golden; while Jonathan, Stark, Delicious, Wagner, Nero, Hubbardston, Mammoth Black Twig, and Duchess also reach perfection. York Imperial and Ben Davis do well, but should not be planted, because better kinds succeed as well.

As we go north, and as elevations get higher, many of these varieties fall behind in size of fruit and thriftiness of tree. In northern Pennsylvania, Ohio, New York and similar localities, Stayman, M. B. Twig and Delicious are of even better quality than they are farther south, although they are not quite so large. Duchess is finer here than anywhere else. Baldwin, Spitzenburg, the Greenings, Stark, Winter Banana, Rome Beauty, Spy, King and McIntosh Red all succeed wonderfully here. McIntosh, Hubbardston, Baldwin, Stayman, Duchess and the two Greenings do best at the higher elevations, while others thrive best at the lower elevation of this section. Northern New York, Michigan, Ontario and New England comprise another belt in which Baldwin, McIntosh, Spitzenburg, Spy and Greenings, Ingram, Stayman, Winter Banana, Duchess, Snow and King are best.

We will not attempt to describe these varieties here. Harrison's regular catalogue gives detailed descriptions. The varieties named ripen at all seasons and are adapted to various purposes. We simply have told you the names of those few kinds which we know are best for each section—kinds that are standard and reliable. You can depend on this list, but if you think of planting and are puzzled, write to us, giving full details, and we will take up the matter with you personally.

The dangerous enemies of apples are as follows:

Apple Rust (or Cedar Rust), from red cedar trees. This fungus does most of its damage in the Virginias. Destroy all cedar trees in the vicinity. **Apple Scab,** a fungus, shows its presence by greenish-brown spots which enlarge and run together, forming good-sized blotches. These later turn black. On apples it makes scaly, blackish or cracked spots, and spoils them for use.

Bitter Rot on fruit, and **Canker** on limbs, are due to fungi. The small brown sunken spots spread quickly and cause the whole apple to rot. Rotten spots are marked by rings, and taste very bitter. **Collar Blight** of apple, caused by bacteria, is almost the same as **Fire Blight** of pear, and should be treated in the same way. **Crown Gall** (bacteria) attacks young trees in the nursery. Its mark is a bunch of hairy roots, galls, knots or corky enlargements near the crown. Remove the trees affected.

Leaf Blight, or **Frog Eye,** a fungus, shows spots on leaves that look like the eye or ear of a frog. The leaves turn brown

at these spots, and drop early. **Fire Blight** (known as Pear Blight or Twig Blight) is caused by bacteria. It begins at the end buds on new wood, and literally walks down over the limbs. Leaves die and hang on all summer. **Sooty Blotch** appears as a smoky black deposit on nearly ripe fruit.

The Aphides, or **Plant Lice,** are small, green, soft-bodied insects that live on young twigs and on the under sides of leaves. They are sucking insects, and by boring into the stems cause the leaves to die. **Leaf Hoppers** are handsome little yellow and red bugs that suck the juice out of leaves; aphides treatment kills them. **Oyster Shell Scale** is so called because the covering over the eggs of these sucking insects resembles that shell in shape and color; there are two broods a season. Badly infected trees look rough and sickly.

San Jose Scale is a sucking insect. You can see it in winter as a round, dark gray or black spot, the size of a fly speck, with a spot or nipple at the center. When trees are infected badly, a rough, scaly crust comes off when diseased twigs and bark are rubbed. On fruit the spots are surrounded by a reddish ring. The young, which begin to appear about the first of June, are lemon-yellow at first, but soon cover themselves with white scales and look like wood-ashes.

Woolly Aphis are sucking insects which infest the whole tree, roots and all; they are covered with a mass of bluish-gray fibers, like bunches of cotton. **Bud Moths,** when young, are small, brown caterpillars with black heads, that *chew* the young leaves and buds, which they bind together in their webs. **Canker Worms,** or **Measuring Worms,** hatch from eggs about the time the buds burst, and feed on the foliage for about four weeks; they stay in the ground over winter and lay eggs on twigs in the spring.

Curculios, as adult insects, appear in early spring and feed on young foliage. They feign death when disturbed. The eggs are laid in half-round cuts on the side of fruits. The young bugs tunnel around within apples, pears, quinces, etc. These are not the real apple worms, however, as those are the larvæ of the **Codlin Moth.** That insect hatches two broods a season. The first eggs are laid on leaves or young fruit, then the worms enter fruit at the blossom end; the second brood appears about midsummer and enters the apple through the side. Control the first crop and the second will give little trouble. This is about the most destructive insect that attacks apples, but is controlled easily.

After apple trees are cleaned up from accumulated damage resulting from neglect, two sprayings a season ordinarily will be enough to protect them. A third spraying, however, will almost invariably pay several times its cost, and sometimes is required for protection.

PEAR

Light or sandy soils are not so good for pears as heavy loams or clay. Pears stand more water than peaches or apples, too, but still should not have wet feet—a requirement that

holds good generally in fruit-growing. Pears do especially well under the sod-mulch system of culture. Always avoid too much tillage, nitrogen and stable manure—give more potash and phosphoric acid.

Try to get the trees to begin ripening wood and fruit earlier in season than apple trees. Grow good-sized trees in the first four or five years, by careful planting and fertilizing, then make them get down to bearing fruit as rapidly as possible, without much regard to more growth. On bearing trees cut back the tips of new wood in May or June, prune moderately in the spring, and thin the fruit. You will have no trouble in getting plenty of pears of high quality if you do this.

Kieffer is the kind for commercial orchards on a large scale, because of the sure crop, the quantity yielded, and the ability of the fruit to stand handling. Bartlett is not far behind, however. It is a summer pear, of finer quality for eating fresh than Kieffer, but it pays for this by being so mellow and tender that it will not stand so much handling. It should be picked a week before fully ripe.

Anjou, Lawrence and Clapp's Favorite need no introduction to the majority of planters, and each is suited to a special condition, under which it is unexcelled. Anjou and Lawrence do well higher up than Clapp's Favorite. Seckel is the highest quality pear known. It is small and very mellow. Duchess, Flemish Beauty, Le Conte, Worden-Seckel, Garber, Manning's Elizabeth, Winter Nelis, Bosc, Howell, Sheldon and Vermont Beauty are good also, and succeed nearly everywhere. There are many other varieties of pears which have merit, but better stick to two or three best kinds for commercial orchard.

Cross-fertilizing of blossoms is very important with pears. Where this is not sufficient, the fruit is liable to be small and poor, rather than fewer in number. Time of blooming has to be taken into account, also, as varieties differ widely. Anjou, Flemish Beauty, Garber, Howell, LeConte and Kieffer, for instance, ordinarily will shed their petals before the flower buds of Vermont Beauty and Winter Nelis are open. Clapp's Favorite, Manning's Elizabeth, Duchess, Lawrence, Bartlett, Seckel and Clairgeau are between these two classes, and are likely to be fertilized by both. Local information on this matter is valuable. Spend a few days in observing pear trees blooming in the locality in which you intend planting.

Pear foliage is tougher than that of most other fruits, still many enemies have to be reckoned with. **Leaf Blight** and **Fruit Crack** is fungus that causes reddish spots on the tops of leaves, brown spots underneath, and pink spots and cracks in the skin of fruit. For **Fire Blight, Scab, Rot** and **Oyster Shell Scale,** see the data under Apple. **Pear Midges** are mosquito-like flies which lay their eggs in the little fruits. From these hatch maggots which later cause the fruit to crack and drop, then the maggots spend the winter in the ground. **Pear Psylla** are sucking insects. See under Apple for the other scales, **Caterpillars,** and **Codling Moth. Pear Slugs** are greenish black, slimy worms that chew on the upper sides of leaves.

PEACH

Locate a peach orchard on a north slope if you can, but if you can not, do not hesitate to plant in a different exposure. As with apples, the higher elevations produce the finer fruit. The kind of soil makes little difference so long as it is well drained. Peaches will neither grow well nor bear when they have wet feet. Protect from frost as much as possible in the ways discussed in the chapter on frost. Peaches are the most tender of fruit trees.

Peaches *must* be cultivated. That is, the soil must receive treatment which will give the trees enough moisture, enough available plant food and sufficient fine earth in which the roots may feed. The time to begin cultivation is a year or more before the trees are planted. All that has been said about planting trees in general, and about planting apple trees in particular, applies to peach-tree planting. In cultivating bearing orchards, do not plow them in the spring until after the blossoms have come.

When buying peach trees, remember that if you can get one-year-old stock at fifty cents each and two- or three-year-old trees for nothing, you will find the two- or three-year trees the dearer in the end. Young trees should be headed low. Do not be afraid you cannot get the horses under the limbs, as most of them will stand up out of the way during cultivating time. A small mule is better than a big horse in a peach orchard, anyway.

In pruning peach trees, remember that they bear fruit only on wood a year old—that is, only new wood this year will produce fruit next year. Half to two-thirds of each season's growth is the right amount to prune off. Peaches will not produce profit unless both pruning and thinning are regularly done well. The markets always have plenty of little, off-color, and insect-damaged peaches, but never enough good ones. Grading and packing has an extra-large share in securing high prices.

Growing peaches is a specialist's job. Wonderful successes are to be made by studying the needs and nature of this fruit, while failure to do the right thing almost invariably results in disaster. You must watch every point that has any influence on trees or fruit or price. Under good care, a peach orchard will live twenty-five years or longer; but the safest plan is to calculate on getting back the cost of the orchard, and your profit, from three crops, giving the orchard ten years from the time it is planted in which to do this. You are likely to get two or three times this, but you *may not.*

Of the varieties, Ray is in a class by itself. Few others are so good, and none surpasses it when considered from the standpoint of all-round excellence. Ray and the following twelve kinds are recommended for a complete orchard, ripening from earliest to latest, in all of the country east of the Alleghanies, from Georgia to Maine: Carman, Mountain Rose, Champion, Moore's Favorite, Belle of Georgia, Reeves' Favorite, Old

Mixon Free, Elberta, Stump the World, Crawford's Late, Fox's Seedling and Chair's Choice.

In Michigan, Gold Drop, Kalamazoo, Smock and Salway are great successes. Hill's Chili, Champion and Crosby are among the most hardy, and do well far north. Another and second-best list for anywhere east of the Mississippi river and north of Louisiana, including the Atlantic Coast states, in order of ripening, would be these:

Mayflower, Greensboro and Hiley for first ripening; Mamie Ross and Waddell for second; Slappy for third; Crawford's Early and Cornet's, fourth; Captain Ede and Thurber, fifth; Frances, Lemon Free, Niagara and Steven's Rare Ripe, sixth; Geary's Hold-On, Smock and Wonderful, seventh; Ford's Late White, Salway and Willett, eighth.

Peaches of the seventh and eighth classes as listed are adapted particularly to mountainous sections. All of the very late kinds seem to thrive better on high land than on low. In the mountains of western Maryland and eastern West Virginia, Mountain Rose, Billyou's Late October and other similar kinds reach great perfection, while they do little good in Delaware and the Eastern Shore of Maryland. In the same way, many of the kinds which succeed best at the lower elevations practically are failures on higher lands. Before you plant, talk to local peach men, and learn what they have grown successfully and unsuccessfully.

Planting of different varieties within reach of one another is not so important with peaches as with apples or pears, yet it should be done. All peaches in any one neighborhood seem to bloom at about the same time, regardless of when they ripen fruit. It will not, therefore, be so necessary to guard against the failure of early and late-blooming kinds to pollinate each other, though it is well to avoid setting solid blocks of one kind. Anything less than one hundred and fifty feet is a safe distance to have varieties apart when you want them to cross-fertilize.

Peach trees and fruit are very susceptible to injury by enemies; but, with the exception of against one or two troubles, good spraying and other care will protect them almost completely.

Brown Rot, or Manilla Rot is a fungus. It comes first in a small brown-rotted area, which spreads rapidly, especially during wet weather. These rotten places later become covered with powdery white spores. **Little Peach** seems to be a relative of yellows; the fruit grows to about half the normal size, and stays green, sour and bitter until late. **Peach Leaf Curl** is due to a fungus, which causes the leaves to curl, thicken, turn brown and drop.

Peach Rosette is another bacterial disease, something like yellows. Shoots on affected trees grow in bunches and remain short. **Yellows** is the disease for which we have no remedy but the ax. It is not known that Yellows is caused by bacteria, but this is thought to be the cause, and since the remedy is the same, we include it in that class. Watch for the premature ripening

of fruit, undersized yellow leaves that set at right angles to the twigs, and tufty bunches of shoots anywhere on the tree.

Black Peach Aphis are shiny black sucking insects which attack both roots and tops. For **San Jose Scale,** see apples. This always is the same, wherever it appears, and remedies need not be changed. **Curculios** that attack pears are about the same as those that attack apples. In all stone fruits—cherry, peach, plum, etc.—curculio larvæ infest the flesh next the seeds, causing the fruit to rot and drop. **Fruit Bark Beetle,** or **Shot-Hole Borer,** attacks only weakened trees. The little black bugs dig a channel an inch long under the bark. **Lecanium Scale** is a large brown scale, hatching in midsummer and crawling about for a short time; it is a chewing insect.

PLUM

There are four classes of plums, each having a predominating characteristic for which it is valuable. The American or native class, marked N, is very hardy. Its varieties bear many individual fruits of the smaller sizes. The Japanese class, marked J, bears choice fruit, and is adapted to the widest range of territory. Trees of varieties in this class are hardier than peaches, but not so hardy as apples. The European class, marked E, bears the finest fruit of all. It succeeds over a more limited area than the other types.

Plums must not be grown on soil that is *too* wet, but they ought to have plenty of moisture, as they will not stand dry weather well. Heavy lands are better than light, although the Japanese kinds do well on soils lighter than the others will succeed in. Two-year trees are the best to plant. The work to be done is much the same as with the cherry, peach or apple, and you can safely follow the directions given in the chapter on planting, in the distance tables, and elsewhere.

Plums must be pruned. Some kinds need more than others. The upright-growing varieties must be pruned by a system entirely different from those used with the sprawling kinds. Fruit is borne on wood two or more years old. Nearly all kinds require tip pinching. Keep the head open so that light can get in, and keep the bearing wood cut back enough to insure that trees will not break with their loads of fruit after a reasonable amount of thinning is done.

Red June (J), Satsuma (J), Wickson (J), Burbank (J), Abundance (J), Bradshaw (E), October Purple (N), Ogon (N), and Shropshire Damson (E), all are good sorts. They will overlap in blooming time enough to cross-fertilize. Two or more varieties should be planted withing reach of one another for this purpose. An individual plum tree will set fruit, but it will not be so fine as that produced when another kind assists.

Enemies to plums are overcome easily by proper treatment, yet do serious damage when they are left alone. The bacteria of **Black Knot** and of **Crown Gall** are the same with the plum as with the cherry or apple. **Brown Rot** of plum is the same fungous trouble that comes to peaches, while the **Scales** (suck-

ing insects), and the **Curculios, Borers, Shot-Hole Borer, Slug** and **Caterpillars** (chewing insects) all attack plums. All of these are the same as these enemies on cherry or peach trees.

QUINCE

In this country there are grown far too few quinces, even for home use. Their flavor alone would make a market for two or three dollars' worth with every family in the land, were the quinces to be had. This amount should buy from fifty to seventy-five quinces. It is easy to pack and transport the fruit in perfect condition. Ordinary apple hampers, boxes, and barrels, or peach and grape baskets, are the packages in which to market them. Quinces are high-priced fruit, and good specimens are worth taking the best care of. Use wrappers for the individual fruits, and line the package with either plain paper or the corrugated caps. They should be packed without too much pressure, yet must not be loose. They should be picked while still a little green, even for home use, and ripened in a dark room.

Quince trees will grow in any soil, but succeed best in heavy clay loam. They like plenty of moisture. The average hillside or top is too dry for the best results, but a soggy place will not do. The higher they are planted, however, the less trouble there will be from fungi. Underdrain a good damp soil and it will grow fine quinces—trees and fruit. Thorough tillage is almost necessary, yet a very heavy straw or hay mulch may do good work. The roots run close to the surface, so do not cultivate deeply.

Pruning must be done regularly and by a system. Head back the new growth and thin well each spring; then, if possible, cut the tips back again in June or July. Quinces are real trees, not shrubs, if treated right. The trees should have short trunks and a round, shapely, well-branched head. Start with a straight stem from eighteen inches to two feet high, and grow your trees as they should be grown. Keep all suckers cut off from the trunk. *Remember that the fruit is borne on shoots of the same year's growth, which grow from wood at least two years old, and prune accordingly.*

It is best to select at least two varieties when you plant, on account of cross-fertilizing of blossoms. If you plant only two trees, get different kinds. In an orchard you could use three or four varieties to advantage. Orange, Champion, Meech, Bourgeat and Mammoth all are good. For home use the first three are to be preferred, but all are valuable commercially.

It is a mistake to suppose that quince trees are attacked by so many enemies that they cannot be grown in the East. There are many enemies, but not so many as attack the peach, nor are they so difficult to control. Quince foliage is tougher and will stand stronger sprays than peach. **Black Rot** is a fungus which attacks quinces at the blossom, and, when they are about half grown, fruits rot, shrivel, and hang on for months. **Blights, Rust, Scab,** and other fungi, also attack Quince.

Aphides and the **Scale** are the sucking insects attacking the Quince, while **Curculio, Codlin Moth, Bag Worm, Caterpillers** and **Borers** are the chewing insects. These are all the same as on the apple.

CHERRY

In all parts of the East, cherries seem to thrive especially well, but it remained for Colorado and the Pacific coast to show what could be done in growing them. New York has some commercial cherry orchards, but the East does not grow one-tenth of the cherries it uses. Go into the better markets during the cherry season, and you will find that California and other Western states have supplied nearly all of this fruit.

Medium-sized, one-year, unbranched trees, especially if they are of sweet varieties, are surer to grow than heavier ones. Two-year trees, however, are good when properly dormant. There is a world of difference in the growth and habits of sweet and sour cherry trees. In general, it can be said that the sweet do best on high land and in mountainous districts, while the sour reach their greatest perfection down lower, and on lighter soil. If there is a choice, select a light loam, gravel or similar soil, although cherries will thrive in any place that is not damp. They will not succeed to any extent in a seepage place that is not drained. Trees that are propagated on Mazzard stock are hardier and thriftier under adverse conditions than those on Mahalab or native stock; hence, get trees on Mazzard stock for exposed places and for northern districts.

Cherry trees are prone to grow too fast, splitting the bark on trunk or limbs and doing other damage. For this reason, and because the fruit ripens much earlier than other tree fruits, cultivation should stop about the beginning of June. Never use very heavy mulches under the trees, nor much, if any, stable manure. Nitrate of soda, or any fertilizer containing much nitrogen, is liable to do more harm than good. This, of course, depends upon the soil. A poor soil, not deeply torn up at the start, will demand more nitrogen and cultivation to feed its cherry trees than a porous and mellow soil. But, in general, cherries will thrive best when the ground is seeded to grass and kept that way.

The less cherry trees are pruned, the better for them. It is necessary to cut back the trees at the start, and to shape the head while it is growing. Cut out limbs that cross each other let in the sunlight, and remove dead limbs. That is about all that will be needed. Fruit is borne only on wood that is two or three years old. As for marketing, only a few words are to be said, yet these are of great importance. Remove all imperfect cherries, then pack the perfect ones in wooden boxes such as are shown in the packing scene on page 117. They should be arranged in rows, and must not be loose. On almost any city market you can get from fifteen to twenty-five cents a quart for good cherries packed in this way.

The choice of varieties depends upon the color and flavor you

want more than on anything else. Black Tartarian, Governor Wood, Napoleon, Schmidt, Bing, Lambert, Windsor and Yellow Spanish are good sweet kinds, which vary in color from black to red, brown, and bright yellow. Baldwin, Dye House, Early Richmond, English Morello, May Duke, Montmorency, Reine Hortense and Wragg are good sour kinds of various colors. English Morello, Montmorency and Early Richmond are late bloomers, Baldwin is medium, and the rest are comparatively early, yet doubtless all will overlap enough to cross-fertilize. Do not plant one kind alone; much better results can be secured when two or more different varieties are within a hundred feet of one another.

Cherry trees do not have many serious enemies, but should be sprayed and looked after regularly. **Black Knot** can be recognized by the thick swellings on twigs, which later develop into black, warty growths, and break out all over the tree. It is caused by bacteria. **Brown Rot** of cherry is the same as of peach. **Plum Leaf Blight,** or **Shot Hole Fungus,** appears in small purplish spots, which turn brown and drop out, leaving a little round hole in the leaves. **Cherry Aphides** are shiny little plant lice, brown and black, found thickly on the under sides of leaves in May and June. They cause leaves to curl and drop early. **Woolly Aphis** is the same on cherry as on apple, as is also **San Jose Scale. Curculio** of cherry is about the same as apple curculio, eating away the flesh of fruit next the seed. **Slug** is the same as on peach. If **Birds** eat the cherries, hang bits of bright tin on limbs, or put a stuffed or live owl or cat in the tree. If mulberries or service berries are near, birds will not bother cherries so much.

GRAPES

Grapes are grown in all parts of the world, north and south, on high land and on low; they seem to thrive nearly as well in one place as in another. The kind of soil makes little difference, though it is probable that a heavy clay is better than a sandy soil. Vines thrive among rocks, on steep hillsides, and on rich bottom lands. Drainage is essential, as with all fruits, and in low pockets of land frost is likely to catch blossoms. An exposure to the south or the east is better than to the north or west. We cannot give the exact reasons, but know that both vines and fruit are attacked by more enemies when growing on low land than on high. Although it is subject to the troubles mentioned, from which hillside vineyards are free, a valley floor will grow the finest grapes.

Vines are heavy feeders. Their roots extend far out and make a net-work in the soil. The proper distance to plant will be from six to eight feet apart, although sometimes this can be changed to advantage. Strong varieties, on fertile soil, need more room than small growers on poor soil. Before planting is done, the ground should be worked even more thoroughly and deeply than for a tree. Remember that you are planting something which will last a generation, not a crop to be removed

in a season or two. Plow the land, use dynamite to dig the holes, and have a clearance inside the hole of at least twenty inches. After-cultivation should be complete and continuous, stopping each year only in time to ripen the wood and fruit early in fall. Mulch systems do not succeed with grapes.

Use one-year vines if you can get them, though two-year vines are nearly as good. Cut the little vines back to three or four buds, cut the roots back to ten inches in length, and then plant deeply, as early as possible in the spring. You can hardly get grapes too deep within reason. These newly planted vines should be mulched heavily with straw and manure, for two feet about the vine. They require lots of nitrogen, which the mulch will supply while it is saving moisture. Add whatever commercial fertilizer the vines may lack, as indicated in the chapter on feeding plants. For the first season, the canes may be tied to stakes, or allowed to run on the ground. After that they should be trained on trellises, to make easy the spraying, cultivation and picking.

For home trellises, use the form you like or can get best. In field vineyards, the form most widely used consists of posts six feet high, on which are three wires—one at the top, and the others below, about eighteen inches apart. A better way; in our opinion, is to put a cross arm on the post, about five feet from the ground, and string the three wires on this, one at each end, and one in the middle. Train the leaders of the vine up the post, in either case, then let the side branches grow out on each wire, in both directions, half-way to the next vine.

The pruning of grape-vines has to be understood before it can be done with any satisfaction or good results. At the same time, a vine *will not* grow nor bear as it should if it is not pruned, and if it is not pruned right. Grapes are borne on new wood (of the same season's growth), and these shoots spring from buds on wood of the last year's growth. This applies to all American (so called) varieties, but not to the European or Scuppernong kinds, which bear on shoots from two-year wood. So, when we start with a new vine which has grown one summer, all the shoots except one should be cut off in the next winter (December to February), and this one should be cut back to three or four buds. When the next growth starts, only two of the strongest canes should be allowed to live, and these two will form the main trunk of the vine.

The branches that arise from these two main stems during the second season will go into the winter with a good crop of buds. Your two-year-old vine should bear not more than ten or a dozen bunches of grapes; so, in the second winter, cut off all the branches except three or four, and cut these back to two or three buds each, because each bud will average two bunches. In this way, thinning is done by pruning. This principle holds good with any vine, no matter how old it is. One set of roots can mature properly not more than from forty to eighty bunches, depending on the kind and age. Each winter, cut every vine back so that it carries only half as many buds as you want bunches of grapes next season.

A hard, well-ripened cane the size of your little finger is better than one thicker or slimmer, and very thick ones are worth the least of all. As the fruit-bearing shoots spring each year from wood of the previous season's growth, and from none older, your vines will be a few feet longer each year. About every three years, it will be necessary to let two or three new canes start from the original trunk, then cut away entirely the wood that has been bearing. Treated in this way, a vine will bear heavy crops every year for you, your children, and your grandchildren.

Cross fertilizing is absolutely essential with grapes. Go through the woods and see the big, healthy wild grape-vines that are full of bloom, yet do not set a single bunch. At blooming-time cut a branch from a vine bearing flowers of the opposite sex, take it near the barren vine and thrash it about a little. A great number of the blossoms on the vine heretofore fruitless will be fertilized, and will be loaded with grapes. This little experiment will convince you of the need of cross-fertilizing for any fruit. Not all varieties of grapes blossom at the same time, but they overlap enough to do the work. Any two kinds seem to be able to fertilize each other.

Campbell's Early, Moore's Early, Concord and Worden are good black varieties. Delaware, Wyoming, Catawba, Brighton and Agawam are good red ones, and Pocklington, Niagara, Green Mountain (Winchell) and Diamond are good white sorts.

Grapes have many enemies, almost all of which yield readily to spraying and other care. One method of preventing damage is to bag the bunches. This works every time, and does not cost much. When the grapes are about half-grown, paper bags are slipped over the bunches, and either tied around the stem, or split at the top and the two sides wrapped around the cane. These bags will stay on until the grapes are ripe, and prevent damage from all insects and fungi. Other remedies for all grape troubles are given in the spraying directions, and here follow descriptions of the enemies.

Black Rot, a fungus, first appears on the leaves as small, reddish brown spots, and about two weeks later as light spots on the fruit, beneath which the fruit has decayed, These spots increase in size until they involve the whole berry, which finally turns black, shriveled and crumpled. **Downy Mildew,** another fungus, appears about the time the vines blossom. There comes a dense, white velvety growth on the under side of leaves and on shoots and fruit. This keeps up all summer. **Grape Anthracnose,** or **Bird's Eye Rot,** affects all green parts of the vine, but particularly the shoots and fruit. Little round brown dots with a border appear on the shoots, and gray, red and brown rings, one inside the other, on the berries.

The **Flea Beetle** is a steel-blue bug about an eighth of an inch long, the young of which eat away the upper surface of the leaves. **Grape Berry Moths** look about the same, but from their eggs, which are laid in June or July, hatch white worms that eat into the grapes. **Grape Phylloxera** (insects) are indicated by fleshy growths on the under side of leaves, and by swelled

and knotty roots. Throw infected vines away and get clean stock. The young caterpillars of the **Grape Plume Moth** hatch early in the spring and bind together several leaves at the ends of shoots, feeding on them. **Grape Root Worms** feed on the roots of grapes, staying in the ground all winter, and then, in the spring, come up and feed on the leaves for a few days. The **Grape-vine Leaf-hopper** is a sucking insect, infesting the under sides of leaves. **Rose Bugs** are long-legged, grayish brown beetles, about half an inch long. They are chewing insects.

STRAWBERRY AND OTHER SMALL FRUITS

All that has been said about the care of the soil for tree fruits applies to those which grow on vine and bush and plant. Even pruning of the small fruits should be done with the same principles in mind as when pruning a fruit tree. Less thinning is required, however, unless it be with strawberries. Strawberries are the best possible inter-crop for an orchard. With them you can get a good income from the ground, and give the trees the needed cultivation. Do not plant any berries, or other crop, nearer than four feet to the trees.

In handling any intercrop between orchard trees, remember that you must not stir the soil after the first of August at the latest. It will be better left alone after the first of July. Strawberry plants do not ripen up and become dormant till the ground freezes hard, but fruit trees must be entirely dormant before any hard frosts come, or great damage will result. The same remarks apply to watering the intercrop. Quite often it is possible, even in the East, to irrigate part or all of a strawberry field. For the plants this would be a desirable thing in the fall, but it would be very bad for the trees.

The train loads of berries that go rolling to the big cities every May and June prove that strawberry growing is an important industry in itself, without regard to the plants in young orchards. On the Delaware and Maryland Peninsula, in parts of the Mississippi Valley, in California, and in the Northwest, wide sections have specialized on berry-growing. In these places, nearly every station has an ice-plant near, has a dozen or more berry-buyers' offices, and, in season, long lines of refrigerator cars are loaded every day. Go to these stations in the morning and see the strings of rigs coming in from the surrounding country, loaded with crates of berries picked since daylight.

Strawberries are one of the quickest money crops. They mature a crop fourteen months from planting, and this can be sold for cash. It costs so little to plant a field that no farmer is too poor to do it. They will grow anywhere, in nearly any soil, except clean white sand or soggy clay. The fields in northern Canada and in Florida and Texas seem to thrive about as well as those in Maryland or Missouri. There are varieties for every purpose, bearing firm berries and soft berries, ripening early and late. They can be depended upon for profit, and for the specialist they offer most attractive opportunities.

Young plants, that is, plants that never have borne fruit, are the only ones to use. After a plant has borne two crops, its old roots get dark, wiry, and finally nearly all die. A young growth starts above or below the old roots, but these roots never amount to much. Young plants have white, fibrous roots, and firm, well-developed crowns and stalks, which contain much stored-up nourishment for use when ground is frozen solid, or is too dry to allow the roots to gather more. Another important thing about plants is that they inherit the bearing characteristics of their parents. A plant produced by another that has been well cared for, fed properly, and which has borne a heavy crop of large, firm berries, will likely do the same if given good care. On the other hand, a plant produced by a parent that has been neglected, starved or dried out, and which bore few berries or small berries, will have a tendency to make few fruits, of inferior size.

It seldom pays to get plants from an old fruiting field. Get them from a breeding field or bed. The producer should make his parent plants bear, to see what they will do (no two plants bear alike, and the poor bearers must be destroyed). But the primary purpose of a breeding bed is the production of plants, and for the best results it must be cultivated and fertilized accordingly. In starting a field or bed, it costs little more to get plants that are right in every way, and it often makes a hundred per cent of difference in the returns.

Almost any soil is a good soil for strawberries. It need not be deep. The depth to plow and tear it up will vary with the kind of soil and with its physical condition. Strawberries are naturally shallow-rooted plants, and must be encouraged continually to send their roots deeper, in order to be sure of a supply of moisture and to feed in soil of an even temperature. A light soil should be torn up no more than four inches, while a heavier one must be mixed well as deep as eight inches. We would suggest that you go back and read over the soil-handling directions given in earlier chapters. The essential features are to have the soil fine and loose, in good physical shape, but with no large air-spaces. The surface should be covered with a loose dust mulch to prevent evaporation. Plowing, disking, harrowing and rolling are all needed, the amount of each depending on the situation. Berries must have plenty of moisture and plenty of food, and half the battle to get these is in putting the soil in shape.

The richer the land the better for berries. Barnyard manure is one of the best possible fertilizers. Five hundred to eight hundred bushels an acre is not too much, and it should go on with spreader. They need lots of nitrogen. If dry, irrigate them during April, May and June, if possible. It will pay (see pages 9 and 10).

Spring is the time to plant in all sections north of North Carolina. South of that state fall planting is advisable sometimes, yet if planting is done during late winter or very early spring, whenever the ground can be worked, better results usually will be had. In the North, planting should be done the

Garden trellis for grapes, also grapes under glass.

Grapes bear only on new wood. Each bud will average two bunches on new shoot.

Bartlett pear orchard. Sod mulch is ordinarily better than cultivation for pears.

The way to pack cherries to realize big prices—but it requires proper packages.

Commercial orchards of cherries pay more than apples if proper care is taken. These trees have been cultivated, sprayed, shaped and watched right.

Strawberries are the standard inter-crop in young orchards. They always pay.

Scenes near stations where co-operative marketing is carried on. Growers are bringing in fruits and produce of all kinds, and selling it right there for highest market prices. Future fruit-growing success depends on co-operative selling.

Fruit stand in New York. Note packages. Prepare your fruit for this and you will have no trouble in getting high prices. Careful spraying, grading and packing most essential.

first day after February when the ground can be worked, *after it has been prepared properly, as outlined.* Mark the rows with a cord or a scratch made with pegs in a plank. Transplanting machines will do the work about twice as fast as it can be done by hand, but not so well. The very best way to set strawberry plants is to get down on your knees and use a trowel or dibble. The one great trouble with machines is that they set plants too deep or too shallow. The crown should come right at the surface, not a half inch below or above. Roots are better spread out as tree roots must be, but many growers simply drop them into a hole and pack the dirt firmly. A little experience will teach any one how to plant properly.

There are three systems of planting in common use: the matted row, the hill and the hedge system. The former is the only practicable system for commercial fields. With it the plants are put in rows three or four feet apart and eighteen to twenty-four inches apart in the row. The first summer runners are left to form as many new plants as they will in a space a foot or so wide (beyond this they are cut off with a cutter on cultivator). With the hill system, one plant is made do the work in each place, and these hills may be from twelve to twenty inches each way. All runners are cut off. The hedge system is really a modification of the hill system, and consists of rows of hills, each plant having six inches or so of clean space about it. The hill and hedge systems make lots of work, though they produce fine berries, and are to be advised for all or part of home gardens.

Mulching strawberries is done to keep soil moist and cool in summer, to protect the berries from mud and dirt when ripe, and to protect plants in winter. The winter protection need not be put on till after the ground freezes, as the plan is to prevent alternate freezing and thawing, and not to keep the ground from freezing. Such a mulch should be loosened up or raked to side of row in spring. Winter protection is not needed south of Maryland. Mulches, where winter protection is not desired, should be put on in spring, when the first thawing begins.

Fields or beds will bear two good crops and no more. They may be renewed for one more year, and sometimes for two, by plowing all the matted row except four to six inches, applying manure heavily, working back to the remaining plants with a cultivator the thrown-out soil, then cutting out all the old plants left, and enough of the new ones to leave those that remain six or eight inches apart. This work should be done as soon as possible after the crop is removed. If the old plants are diseased, burn over the field before plowing. This will not kill the plants.

Cross pollination of strawberries is very important. The blossoms are of two kinds. One kind is pistillate only (such as Haverland and Bubach). These are called imperfect, and they cannot set fruit without help from another variety. The other kind are both pistillate and staminate, and are called perfect. They can set fruit if no other kind is near, and they can fertilize other pistillate kinds, but their fruit is finer if they are cross-

pollinated by another staminate kind. Reliable growers usually give the sex of varieties in their catalogs. One row of staminate blossoms will fertilize two rows of pistillate kinds. It is well to alternate varieties to some extent, no matter what kinds are planted, because plenty of pollination always results in the finest fruit. The sex of a blossom can be told from its appearance. The pistillate kinds will have at the bottom of the flower only a cone-shaped mass or body (the undeveloped fruit.) The staminate kinds have this and also many upright "stamens" on the ends of which the pollen is borne.

We will recommend just five kinds for the commercial grower—Millionaire, Klondyke, Gandy, Haverland and Parsons. For home gardens the list can be extended to a dozen or more, and they should be selected with consideration for color, quality of flesh and season of ripening wanted. Get those kinds that bear firm berries or soft ones, that are deep or pale red, and that ripen all the way from earliest to latest. There is much talk now of an everbearing Strawberry. Doubtless before long this will be developed to a satisfactory state, and, when it is, we can have Strawberries from May until October.

Berries should be picked with the stems on, as they keep better this way. Of course no one would think of trying to ship berries without stems. Picking should be done while the berries are cool. The best time is early in the morning, before the sun has warmed them up. Do not let them remain in the field, nor let the sun shine on them. If you do not take them to the railroad station and the refrigerator car immediately, get them into some kind of cool or cold storage without delay. The market package is standard all over the country—the quart boxes carried in a crate. Put the berries into these boxes as you pick. A basket carrier is needed for fast work.

The berries should not be picked while there is any green about them. It does not pay. Grading should be done carefully. Pickers will have to do this, and they must be taught its importance. Good prices depend on uniform, proper grading and packing just as much with Strawberries as with apples. In seasons of low prices, and to take care of the culls, in any season, large amounts of berries may be processed—made into the fruit syrups used in confectionery and in flavors. At least five cents a quart can be realized in this way. The equipment is not difficult to install or handle, and any Strawberry neighborhood can afford one. Write us and we shall be glad to give you the details.

Enemies of small fruits fall into the same classes as those of tree fruits, and must be combated with equal care. Among those of Strawberry plants, *Leaf Blight* needs no description. It is a fungus. *Root Aphis* are the little blue insects that live on the roots and *suck* out the sap. *Leaf Roller* is a small brown caterpillar. *Slug* is the same as on cherry or peach. *Strawberry-crown Borers* are the young of a drab beetle about half an inch long, and *Strawberry Weevils* are little black beetles that lay their eggs in the fruit buds of the berries, then go below on the stem and cut it, causing it to wilt and drop over.

SPECIAL THINGS NEEDED BY FRUITS

Currant Anthracnose appears as small brown or black spots on the under side of leaves. *Leaf Spots* of other kinds also cause the leaves to yellow and drop early. All are caused by fungi. *Currant Aphis*, *Currant Leaf Hopper*, *Four-lined Leaf Bug*, *San Jose Scale* and *Scruffy Scale* attack currant bushes. All are sucking insects. *Currant Borers* and *Currant Worms* are chewing insects, needing no description. Most of these enemies also attack other small fruits. *Gooseberry Mildew* attacks both leaves and berries. Its mark is the cobwebby covering on leaves and buds, and it is a fungus. *Gooseberry Fruit Worms* make their way into the berries and eat out all the pulp. They are chewing insects. *Leaf Spot* or *Blight*, *Mildew*, *Tomato Rot*, all are fungous enemies of the tomato. *Bacteriosis* of tomato is caused by bacteria. The marks are sudden wilting of foliage, and a change from green to yellow and brown. Many insects infest tomatoes; the treatment for all is the same. What is known as *Sun Scald* on raspberries, etc., really is *Anthracnose*, a fungus. The marks are purple spots on young shoots, which, growing and extending, finally girdle and kill the canes. *Crown Gall* of the small fruits is the same as that of peach. It comes from bacteria. The same is true of *Orange Rust*. *Rose Scale* can be seen on the canes, near the ground. *Blackberry Gallmaker*, *Raspberry Cane Borer*, *Slug*, and *Tree Cricket*, all are chewing insects on small fruits.

SUMMARY

The location for an orchard should be chosen with reference to elevation, air-drainage, water-drainage, soil and nearness to transportation facilities.

Varieties differ in season of ripening, color, flavor and texture of fruit, but to an even greater extent in adaptation to various elevations, latitudes, etc., in habit of growth, and in disease- and insect-resisting ability. Carefully choose the kinds suited to your locality.

Cross-pollination is most important. To secure it, plant different varieties that bloom at the same time, within 150 feet of each other.

For any one locality there are only a half dozen or so kinds that head the list. Commercial orchards should contain no more than three or four kinds, and small orchards only two kinds. With carload lots of one kind you can command the attention of buyers and get much higher prices.

Marketing

THE big profits in growing fruit depend upon the manner in which fruit is harvested and marketed, more than upon any other element. Picking, grading, packing and selling really constitute one operation, since all help toward one object—the placing of the fruit in the hands of the users in the best possible condition. While the average grower has much to learn about varieties, feeding, pruning, spraying, and other care, he must count his work a failure unless he knows also how to *get the money* for his fine fruit.

Fruit should be picked at exactly the right time. A good way to tell when to pick most fruits is to lift them up gently—if they are ready to pick, they will come from the spur easily when you give them a little twist. Unless there is a tree trouble, or unless a variety is out of its latitude, this is a reliable guide for apples. Pears sometimes should be picked when they are a little greener. The softer varieties, like Bartlett and Seckel, especially, should come off a week before they take on their full colors. Peaches, plums, cherries and grapes are best when picked at the stage when they have colored-up well, but still are firm and hard. This is for shipping or keeping. For immediate home use, let all fruits except quinces mellow on the trees. In no other way can they get such flavor as is given by the sun and the wind.

Be sure to leave the stems on all fruit except peaches and some plums. Apples from which twenty per cent of the stems are missing will be objected to on the best markets. Cherries and plums will not keep without stems. (But cherry stems ought to be clipped with shears after picking, leaving from a quarter to a half-inch only on the fruit.) With any kind of fruit, these stems come from a fruit spur, and from only one of several fruit buds. If you leave that spur and the buds undamaged, they will set fruit again next year. To break the spur or any of the buds means that you are deliberately killing a half-dozen fruits of the next two or three years' crop. See a detailed explanation of this in the chapters on thinning and pruning.

Use baskets, rather than bags, to pick in, either of wood or canvas. The wood ones generally are best. Get those with the hinged handles that will enable you to empty the fruit out without dropping it an inch. Baskets that are open at the bottom are to be had on the market, and are very good. You can have a blacksmith make hooks with which the basket can be hung at the side of the ladder or to a limb, where both hands can reach it, or a strong hook made in the shape of an "A" will hold two baskets. If trees are high, have a rope and pulley with which a helper on the ground can lower the baskets while the picker works. Fruit in bags will be bruised when pickers climb over ladders and limbs. Employ men who will pick with both hands—the one-handed picker is closely related to the one-handed milker. Better stop picking during

hot, murky days. No picking equals that done with your hands, yet some of the patent pickers might be used for the fine fruits out on the ends of tall limbs.

Ladders should be light and strong. Extension ladders will be good for high trees, but ordinarily the best are made from *dead* white pine poles cut in the woods, with cleats nailed on. These are light, very strong, and cheap.

For peach trees, a three-foot picking bench is often what is needed. The next higher is a two-way step-ladder, with a platform near the top on which to set the basket. This is good for young apple trees too. A longer ladder arrangement, that can be moved about easily, is made by using a couple of strong wheels, of any kind and size, and axle, and two handles like wheelbarrow handles. The lower ends of two six-foot uprights are bolted to these handles near the axle, while the upper ends are bolted to the ladder eight feet or so from the bottom. Ladders should be laid into trees gently, and fruit should be handled like eggs.

As soon as possible after the fruit leaves the twigs, get it into cool storage. Some of the best growers do not allow picked fruit to remain in the orchard or grading-houses more than thirty minutes. Fruit cooled quickly will keep longer and in much better condition than that left to lie around. *Under no conditions pile fruit on the ground or grass in the orchard.* Crates, bushel-boxes, barrels, etc., are all good for use in carrying apples and pears from orchard to grading or storage house. Peaches, plums and grapes should go in baskets or hampers, which are firm and solid. Shaky and yielding baskets will bruise fruit.

Low-wheeled, broad-tired wagons, with a platform higher than the wheels, and no bed—just a four-inch rim—are best to haul fruit on. At the sorting-house or storage-place have platforms just about as high as the wagon platform, to make unloading quicker and easier. One grower uses large coffee-boxes to haul apples in, and loads these side by side on a wagon made by fastening two long, springy poles to the front and rear bolsters of a long-coupled wagon. Spring wagons are made that do good work, and one or two automobile makers offer big trucks that are efficient.

What is first-class fruit? Take apples, for instance. The grading of other fruits is governed to a certain extent by the rules that apply with apples. That is, all fruit is graded for color, size and perfection, and any one who can correctly grade apples can grade the other fruits by applying common sense. "*Standard*" big apples must be more than two and one-half inches in diameter. A *standard* small apple must be more than two and a quarter inches. These are the firsts, in regard to size. The next *standard* smaller size is a quarter of an inch less in each case. Size makes little difference in the selling price, so long as the apples are up to the mark in other things. All the apples in one package must be uniform in size and in color. The rules of all selling associations of the West, and the regulations under which fruit is judged at all the big shows are that

the diameters of the different apples in the same package shall not vary more than a quarter of an inch. Most graders make only two classes for color—the brilliant apples and the pale ones.

After size and color come shape and condition. Lop-sided or uneven apples are not wanted. Of course, this is a matter of variety to a certain extent, but the idea is to have them as even and smooth as possible. Worm-holes and all other insect damage, fungi damage and bruises *must not* be there. Judges will insist on fruit being ninety-five per cent perfect in this. The fruit must be *flawless* to get high prices. The other fruits are governed by the same general rules, each in its own way. Grade your fruit so that in one package you have only those specimens of about the same color, and of the same size to within a quarter of an inch. Never mix varieties.

A packing-house, or grading-house, should have plenty of wide doors, and usually is filled with tables. Grading tables are sloping, with padded rims and tops. The fruit is brought from the orchard and slowly poured down these tables past the sorters, who separate and direct it into different chutes which lead to canvas or other receptacles that will not bruise. Often the whole table top, chutes, baskets and guides, etc., can be made of canvas better than of any other material. Grading is done with the eye, mostly, but beginners may find that a thin board with holes the exact diameter they want the apples will help to train the eye. Try the apples into the holes when you hesitate.

There are many grading machines, nearly all made by cutting holes of the right size in an inclined board, and then rolling the fruit over these holes. The best grader we have seen is in use in the Hamilton orchard, in Colorado. It is the first real grading-machine, and is run by power. The owner of this machine cuts the holes in belts. If he wants six sizes, or three sizes, he uses that many belts, and cuts holes of one size every few inches in each belt. Then a series of drums or pulleys to which power can be applied are mounted on a frame, so that when the belts are on they will be end to end. If the belts are four feet long, three would make a machine twelve feet long.

Hamilton used two sets of these belts, side by side, for apples—one side for the highly colored ones, and the other for the paler ones. A trough is built, with the belts for bottoms. Felt or broom hangers turn the fruit and brush it into holes. Suppose the holes in the first belt are two and a quarter inches in diameter. When *all* the apples are poured on it, and the belts revolved, those apples of less than that size will drop through the first belt to a canvas chute below, and the larger ones will be carried on to the next belt, which has holes two and five-eighths of an inch in diameter. The last belt in the series can have very large holes, or the biggest apples can go over the end. Such a grading-machine can be made at home for less than a hundred dollars.

Most fruit growers can afford to build a house underground, or partly underground, for their fruit; and this is the best

possible storage, excelling the buildings cooled by ice and ammonia, because all the original fine flavor is retained, and the apples do not lose so much from shrinkage. If you have to store in an ordinary cellar, keep the temperature as uniform as possible, at 40 degrees or under, provide plenty of ventilation, remove warm and impure air and let in fresh, cool air. Sewer pipe and chimney material, properly placed, will do this. Let your cold air in at the floor, and drain the other out at the ceiling. It is not good for the fruit or the people to store fruit in a cellar under a dwelling.

A storehouse can be made cheaply by digging partly, or entirely, into a hill, and then putting over a wooden frame a layer of concrete in the form of an arch, six inches through or thicker. The floor should be of concrete. Such a house should be not wider than twenty feet, but may be as long as you require. It does not take a very big space in which to store several thousand bushels. We know of such a house with a capacity of seventy-five hundred bushels, which cost only eleven hundred dollars.

The fall it was built, the owner had four thousand bushels of apples. At picking-time, he was offered eighty-five cents a bushel, and the buyer said this was fifteen cents above the market. None of them knew of the storage-house. Finally the grower took them to it. When they saw this, they immediately offered him a dollar and a quarter for all the apples he had. The difference between these two offers would have paid more than the cost of the house, without using it. So, by storing his apples, this grower realized nearly a dollar and a half for them that year. Such facilities make you independent of current markets.

The temperature in an underground house can be kept below fifty degrees after the first of October, by taking in cool night air and shutting out warm day air. During November it can be lowered to any degree wanted, and with proper care of the doors and ventilators, the temperature will not vary a half degree all winter. The right temperature at which to best keep various fruits is as follows: Apples 39°, Cherries 40°, Grapes 36°, Nuts 35°, Oranges 36°, Pears, Peaches, Plums, Prunes and Quinces 35°, Vegetables 35°, Watermelons 35°.

Some growers grade and pack their apples as soon as they are picked, while others store them in bulk, and grade them when they are ready to sell. The plan to use depends on the market. In any case, have plenty of barrels, hampers, baskets or boxes. Use boxes whenever possible. It is safe advice to suggest that you pack in boxes all the apples that are fit for storing, and barrels for only those that go into consumers' hands at once, or for the poorer grades that go to drying and processing houses. Barrels have been the common package in the East, but other packages are fast displacing them. Hampers and bushel baskets are good where the shipping distance is only a couple of hundred miles, particularly for fall apples, and those which are too good for vinegar or apple-butter. The standard barrel for this country is seventeen and one-eighth inches in

diameter at the head, inside; the staves are twenty-eight and a half inches long, the chimes three-fourths of an inch deep, and the barrel at the bulge is sixty-four inches in circumference, or about twenty-one inches in diameter. The capacity should be as near as possible ninety-six quarts—three bushels.

Packing in barrels needs little explanation. Make at least two grades of apples, and it is better to make four or five. Face three layers with the stems down in the bottom, then put fruit in to fill up, either by pouring and shaking, or by placing each apple by hand. The latter is best. Face three rows on top with the stems up. Put the same size and color of fruit all the way through the barrel. The top layer should come an inch or two above the top of the staves. Then put the lid on top of these and force it into place with a press, or pole. Screw and lever presses are both good; the latter is the handiest, especially the kind that locks the pressure on while you nail in the head. The hard, unyielding sorts of apples should be squeezed less than softer ones. Thus Spies will stand only an inch or so, while Greenings should go down at least two inches. Do not leave them loose in the barrel, yet do not squeeze them too much. Some packers use a lace-paper circle under head of the finer grades. It always is a good plan to line the barrels with paper, and to use a pad on the top and bottom, inside. This pad may be of corrugated board, but the best ones are made of excelsior. The packing-pad should be thick enough to prevent bruising, yet not so thick as to make a slack barrel. When apples are stored in barrels, then sold without repacking, they should have a double-thick "winter" pad put under the head when taken out of storage.

With hampers and baskets, grading should be the same, but there is little packing to do. Simply pour them in gently. A few growers face the top layer and use a corrugated board under the lid. The lids cannot squeeze the apples much. Hampers go to consumer with the minimum of rough handling, yet this is a style of packing that is not good for shipping more than two or three hundred miles, nor for other than early apples.

"Take-home" baskets are another thing. They are used with all fruit. The idea is to get a package that is attractive, strong enough to be useful afterward, and of a size that will hold enough fruit to be sold at retail for a quarter- or a half-dollar—enough for one family a day or a meal. Such baskets can be packed in the orchard and shipped to the cities in big crates, which keep the baskets from shifting and the fruit from shifting in the baskets. Only the finest fruit, carefully graded, should be used.

The standard *boxes* are ten by eleven by twenty inches, and the "specials" are ten and a half by eleven and a half by eighteen. The first is used three-fourths of the time. The two sizes are needed to accommodate different sizes of apples or pears, but no others should be used. These sizes contain a little less than a bushel, when *level* full, but the necessary bulge makes their capacity *more* than a bushel. *In them, however, fruit is not sold by the bushel, but by the number of apples*

or pears they carry, of a certain size, or tier. The box sizes named here have been proved by long experience to be best. Do not let any one tell you to use some odd size. Following is an explanation of how many apples are in a box, by all the different packs and with all sizes of fruit. In a standard box fruit 2⅜ inches in diameter makes a 4½-tier pack (a tier is a column up and down, the length of the box); 2⅝ makes a 4½-tier, 2⅞ a 4-tier, 3⅛ a 3½-tier, 3⅜ a 3-tier, 3⅝ and larger a 2½-tier.

We recommend that growers use only the diagonal pack. It is a little harder to learn, but is greatly superior, both in efficiency and in looks, to the straight-packed boxes, which are little better than barrels for carrying. Fruit in straight packs will always bruise, and always will have to go into the "slightly damaged" class. Of course, no fruit should ever be put into boxes without definite system. Even facing a row on top and bottom has been tried and abandoned. Therefore, the figures given here refer to the diagonal system only. Any apple packed in a barrel, unless with the greatest of care in handling all the way, is a damaged specimen when it reaches the consumer. A good box will deliver it almost perfect, therefore use boxes whenever you can.

NUMBERS OF APPLES IN BOXES, AND ARRANGEMENT.

Number apples in box	Size expressed in tiers	Number rows wide	Pack	Number apples in row	Number layers deep	Box used
52	2½	2½	2-2	4-4	4	Standard
58	2½	3	2-2	4-5	4	Special
64	3½	3½	2-2	4-4	4	Standard
78	3½	3½	2-2	4-5	4	Standard
80	3½	3½	2-2	5-5	4	Standard
88	3½	3½	2-2	5-6	4	Standard
96	3½	3½	2-2	6-6	4	Special
104	3½	3½	2-2	6-7	4	Special
112	3½	3½	2-2	7-7	4	Special
120	3½	3½	2-2	7-8	4	Standard
150	4½	4½	3-2	6-8	5	Standard
163	4½	4½	3-2	6-7	5	Standard
175	4½	4½	3-2	7-7	5	Standard
165	4½	4½	3-2	7-8	5	Special
200	4½	4½-5	3-2	8-8	5	Special

Just how to arrange the apples for each pack is difficult to describe, although it is learned easily by experience. The beginner soon will discover that certain-sized apples fit best one way, and others another way. This is the basis of all the systems. For instance, with the four-and-a-half tier, 163 apple pack, the bottom layer is started in the lower right-hand corner with two apples, placed side by side. Not one back in the corner and the other out, but both *across* the corner. In spaces between these apples, and at their sides, three more apples are placed, with a fourth at the left-hand end of this row. The third diagonal row has five apples, in the spaces between and alongside the four in the second row. This process is continued till a full layer is made. As you pack, force the apples back against the ones put in first. The second layer of this pack,

following out the system of putting the next apples in the hollows between the last ones, has an apple right in the corner, two more in front of it, with a third to the left of the two, making the second row, then five in the third row, and so on. As you fill the box, put the biggest apples at the center of the box. When the last layer is reached, there should be a bulge at the center of at least an inch. When the thin lid is nailed on, the boards will bend, holding the apples between a spring, in a way, and taking advantage of the first great point in the superiority of the box over the barrel—the flexible package. All kinds of apples can be packed in boxes. The usual plan is to pack only the finer ones. But, if an apple is worth growing, it is worth taking care of, and we are not advocating half-way measures anywhere in this book.

Other packs are put up on exactly the same lines. You will soon learn how by doing it. Remember that the object is not the system itself, but to get the apples to the consumer in the best shape possible. Some apples will be loose in any of these classes, and with these it is advisable to use cardboard between the layers. Some growers also use corrugated paper on the top and bottom of box. In all cases, every box should be lined with two pieces of paper. This comes cut to the sizes wanted. In using, it is necessary to put a fold or pleat in each sheet where it goes into the lower corners, to prevent tearing when the bulge is made. Take a sheet in both hands, fold it toward you with fingers, then back again, then draw it across your knee. Apples should be wrapped in paper. This undoubtedly prevents wilting and keeps the air from them. A tissue, made for the purpose, is better than anything else. It comes ready cut in the right sizes, which are either ten by ten inches or eight by ten, and ready printed, too, if wanted. The cost of these wrappers is about 35 cents a thousand.

Get a neat and attractive lithographed label, showing an orchard scene and your name, etc., to go on the end of each box or barrel. It is best also to have stencils or large rubber stamps with which to mark each package with exactly what is in it, as "3-tier, 88, Stayman Winesap," and your name and address. If you grow good fruit and use care in getting it to customers, you are entitled to the benefit of the good-will you establish. Never make the mistake of trying to get the old packages back for use the next season. It pays to use new boxes or barrels each time. An old barrel or box will condemn the fruit it carries, right away. This applies to fruit packages of any kind. Where to buy barrels, boxes, hampers, baskets, depends upon your location. Watch the advertising columns of the farm and fruit papers and books. Send for prices and compare. The advertisements will be your buying guide for a good many things.

Pears are best packed in the bushel boxes or in hampers. They should be wrapped in tissue paper, first carefully graded, and very carefully arranged. The arrangement in the packages will be same as for apples. Some very fine pears can be shipped in peach carriers and sell to advantage. Plain fruit is handled best without tissue wrapping in hampers.

Many of the directions given for packing apples will give you hints on packing peaches, plums and other fruit. Various boxes and baskets are used for peaches. The best we have seen is the flat box of the West. This is eleven and a half by eighteen inches, and four, four and a half, or five inches deep. Just two layers of peaches are put into it, arranged just as you would place apples of the same size in a box. Peaches should be wrapped if they are fine. The regular one-sixth and one-half-bushel baskets and the high, flaring hampers also are good for peaches. They come in various sizes. Sometimes the fruit is arranged in rows and tiers, but more often it is left in a jumble. The rows are better, of course. The six-basket carrier is invaluable for the little baskets. In packing peaches, the use of corrugated caps and excelsior pads is especially recommended. A thick pad under the lid of a carrier will hold the fruit solid, and will prevent the top layer bruising. Always use corrugated boards under hamper lids. It pays. Quinces may be handled in the same way as pears. Grading these two fruits must be done by hand, and the different classes separated as described for apples. Plums have no special package. Peach baskets and boxes, grape baskets and strawberry boxes are good carriers for them. They should be arranged in rows, but need little wrapping, only the lining paper and the corrugated caps. Cherries are best nicely arranged in rows in flat wooden boxes. They can be marketed in strawberry boxes, but this appears to be a makeshift. Ten-pound baskets sometimes are seen. Grapes should be left to wilt for twenty-four hours before they are graded, and then put into baskets holding three, five, eight and ten pounds. These baskets are shipped in crates, and never are unpacked until they reach the eaters. If it is desired to hold grapes for quite a while in cold storage, or in refrigator cars, they must be packed in barrels and half-barrels, with cork "sawdust" as a filler between bunches.

Drying, processing, making apple-butter, peach- and pear-butter, and vinegar, etc., will use up all bruised fruits. We can not give details here, but the tools and labor involved are within reach of every grower. Learn about them and realize on the windfalls and drops.

As for selling, it's mostly up to you. You can grow good fruit and throw it on the regular market. If you have graded and packed it right, you hardly can fail to make a profit—get from $1 to $2 per bushel for apples, say, and other fruits in proportion. But "the man worth while" will not be satisfied with what the regular market gives him. He will look up his own consumers, or will get acquainted with big retailers or with a good commission-man, then stick to the same people until mutual confidence and dependence are established. They will appreciate the extra care given to the fruit, and pay high prices for it. Sometimes buyers will come to the orchard and take all the fruit you grow at a certain price, or you may be able to work up a trade in shipping your fruit to users all over the country. Unless you can do this, or know your commission house very well, we strongly advise getting buyers to come to the

orchard and buy for cash. You should grade and pack your fruit, however, with all care, and you should keep in touch with the market.

The *very best* way to get the most money out of fine fruit is through growers' organizations. Selling conditions in the East at present are nothing more than a jumble. A few growers have located a market for their product, and are getting good prices, but for the great majority of growers there is nothing better than what some one or two buyers offer. If half of our eastern men could see for themselves how fruit is sold in the West, they would do things differently by the time next year's crop is ready to be sold.

In the West, a smaller or larger number of growers will get together, agree on standard grading and packing, adopt a label for the association, provide storage and shipping facilities in some cases (but this is not vital), hire inspectors, who will see that all fruit is up to the standard in every way, and sell all the fruit through one of the officers. Very high prices are secured in this way. The big buyers know they can depend on the quality of the fruit and the correctness of the pack, and will hotly compete among themselves for your fruit. The processing of second-grade fruit and the handling of by-products, securing good freight rates, buying spraying materials, equipments, and buying market packages, are all done a hundred per cent better by an organization than by the individual orchardists. It does not matter what kind of fruit is grown.

On the Delaware and Maryland Peninsula, and in certain sections of the middle West, another kind of organized selling is carried on effectively. Growers' unions, or farmers' unions' are formed, officers elected, and these men seek out markets for every product raised. They have an office, or remain near the station or landing, all the time during season, and promptly buy everything offered them (for cash or on consignment) at highest market rates. No profit is made, and the total of the prices received is given to growers, after the small running expenses are subtracted. The commission-men in the cities send their buyers to the stations to compete with the union buyers, and many times individuals will do the same. The buyers keep cars waiting all the time, and forward stuff immediately. It is a poor community that cannot load several cars a day all through harvesting season.

The organized selling idea and practice is what the East lacks. Hardly any community would fail to make a big success of such a plan, if two or three live men would start a movement for it. We know that it is successful, and we strongly urge all our friends to try some such system for handling the next crop. We shall be glad to tell you in detail of the by-laws and organization of some of the Peninsula organizations if you will write us.

One last word. *Keep posted. Read farm and fruit papers and books. They will aid you in many a problem, and will help you to make your orchard a success and your life interesting and worth while.*

SUMMARY

Half of the failures to make fruit-growing profitable come from careless and improper picking, grading, packing and selling.

Pick the fruit at the right time. Handle it as you would eggs, rush it into cool storage, carefully grade it into three or four classes, and pack it so it will reach the consumer in as good shape as it grew.

With much fruit to handle, grading machines are time- and money-savers.

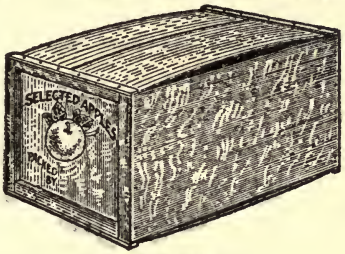
Grading and packing are almost a science. They require study and skill, and their importance must be realized more than in the past.

Always put your name and address on your packages of fruit. Name your orchard, and get an attractive design for package labels if possible.

You can use nearly all culls by drying or processing. Canning, preserving, making syrups, juices, cider, vinegar, etc., are very profitable methods of preventing waste.

In selling, get acquainted with good commission men, or with retail customers, and stick to them, or invite the buyers to your orchard and sell for cash, you to pick and pack the fruit.

If possible, organize a fruit-grower's association. Such an organization will surely be able to get 50 per cent more for all fruit produced than individual growers can. It is the solution of a great many problems that puzzle eastern growers. Through it buying and selling are done from a commanding position, rather than from a begging one. An association can dictate terms to buyers, instead of buyers making the offers.



Special Apple Box
18 x 11½ x 10½

Hamper

Pack Fruit Right!

Shiftless packing accounts for half of the failures to get big returns from fruit. Modern markets pay high prices and demand trainload after trainload of fruit, *but it must be packed right.* The fruit must reach the consumer in practically as good shape as it left the orchard.

Intelligent packing in boxes, hampers, baskets and crates is not difficult, but the right kinds of these packages are not to be had everywhere. Some are made of poorly adapted material, others are wrong in size and shape. It often is difficult to get delivery on time. Many growers are paying too much because modern packages are comparatively new to them, and they hardly know what is a fair price.

COLES & COMPANY

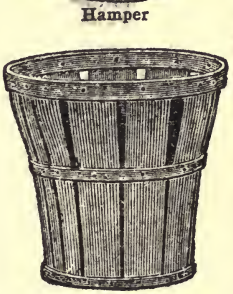
will help you out. This firm manufactures its own packages, has mills and factories in the best lumber-producing sections, and gets cheap water and rail freight rates to its warehouses. It can ship on short notice any reasonable number of any package.

Standard and special apple boxes, shipped knocked down, printed on one or both ends in car lots without extra charge. Hampers, all sizes; peach baskets, all sizes; Cole's Improved Picking basket, with swinging steel handle; Arrow Brand sweet gum berry baskets, excelsior cushions, corrugated caps, lace paper circles, packing paper and tissue fruit wrappers. Get prices on what you need—you will be surprised how low they are. You will be pleased with the quality of the packages and our prompt service.

COLES & COMPANY

Package Dept., 109-111 Warren St., New York City

Be sure to address "Package Department"



Peach Basket

Corrugated Caps

Excelsior Cushions for Barrels and Baskets

Coles' Improved Swinging-handle Picking Basket

Sweet Gum Berry Basket

ARROW BRAND

The genuine "CUTAWAY" tools are used and endorsed by successful orchardists from coast to coast and from bay to gulf

In orchard work, the driver can cultivate under the trees and below the low limbs, the horses not interfering with the branches. The double levers give the driver full control of tool at all times. For regular farm work, the gangs can be drawn together.

CUTAWAY

Single Action Orchard Harrow

Every orchardist and fruit-grower should have one or more of these labor savers and fruit makers. They will positively pay for themselves in one season. To investigate is to be convinced.

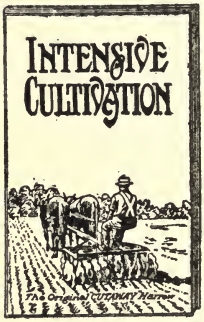
Thorough cultivation makes large crops. Stirring the soil lets in the air, sunshine and new life, and kills foul vegetation. The "CUTAWAY" disc slices, stirs, lifts, twists and aërates the soil. CLARK'S "CUTAWAY" TOOLS run lighter and do better work than any other machine. Lasts a lifetime.

Send today for new catalog, **"Intensive Cultivation."** Of course, it's free.

CUTAWAY HARROW COMPANY

200 Main Street **Higganum, Connecticut**

J. H. Hale, the "Peach King," writes: "The Double Action 'CUTAWAY' is a splendid tool. I use it in polishing off my peach orchards several times a year. A good pair of horses handle it all right."



How to Sell YOUR Apples for Three Dollars a Bushel—We Can Help You Get WESTERN Prices for EASTERN Fruit

Eastern-grown fruit sells in New York and other big markets for one-half to two-thirds of the prices paid for western-grown fruit that is not a whit better.

Eastern fruit is better flavored and will keep longer; shipped only two or three hundred miles, it reaches consumers in better condition than is possible with fruit shipped two or three **thousand** miles.

Eastern fruit is **superior** in many ways to western fruit, and it ought to bring **more** money. It doesn't solely because **Western growers are better organized, and know better how to sell** than those of the East. When a grower or a community learns how to grade and pack, and has standardized the quality of fruit shipped, as well as the condition and size of packages, buyers come after the fruit and pay the prices asked.

There is no secret about getting high prices regularly. System and organization are the things. Twentieth century methods bring the high prices. If you grow good fruit, we can help you get three dollars a bushel for apples, and proportionate prices for other fruits. We have helped Florida growers get more for their citrus fruits than they ever did before. The citrus fruit industry is on a firmer basis there in consequence, and the whole state has been benefited. This is but one instance. Let us tell you how you can simplify your selling problem, and realize the most money.

The McFarland Publicity Service

Harrisburg, Pennsylvania

Keep Posted. Make Hundreds of Dollars More Than You Do

A man in Maryland wanted to spray a peach orchard, but his brother, who owned a half interest, wouldn't allow it. Result: that fall the crop was only 30% of normal in quality, and brought little profit. The first man had seen indications of a certain fungus, and was partly posted, but he wasn't sure, and the second man didn't know anything about it.

A man in Missouri had a fine crop of apples, which had been well cared for—but he lacked marketing knowledge. He didn't know what his apples were worth; he didn't know how to grade them, pack them, where to get packages, or who would buy the fruit. A buyer visited his orchard, offered him $3,000 for his crop on the trees, and he accepted. This was just before picking. The buyer picked almost $20,000 worth of apples from this man's trees. The orchardist had actually lost at least $10,000 by his failure to keep posted.

Another man got to thinking of fruit after he had taken a trip to the city, and when he came home he planted 1,800 trees of a variety which was not in market demand. and what was worse, planted the block solid with the one variety, which would not pollinate itself. He now has to top-work all those trees.

Don't throw away so much money

These are not exceptional cases, either. There are buyers who simply look for the unposted man, and when they find him, they soak him hard. The need of keeping posted runs through all the fruit-growing game. You can gain a year's growth sometimes by some kink in planting, save ten dollars here and fifty dollars there by a little different spraying, increase the bushels and the quality by careful pruning, or double your money receipts by properly grading and packing your fruit.

REGISTERED TRADE-MARK
BRO. JONATHAN

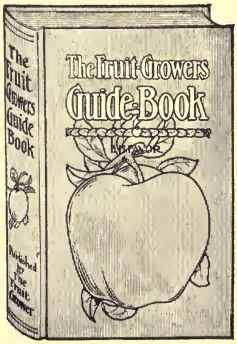
There's just one way to keep posted

Read **The Fruit-Grower,** and read **The Fruit-Growers' Guide-Book. The Fruit-Grower** is easily the leading fruit and farm paper of America. It is so much more meaty and practical that no others claim to be as good. It will tell you what growers are doing to get bigger and better crops, will tell you where to get supplies, what your crop is worth, and where to sell it. The things it will tell you will be worth to you more in a year than the best man you could hire.

THE FRUIT-GROWER'S GUIDE-BOOK has almost 300 pages, cloth bound and is a business book from the first page on. This advertisement appears in a very good fruit book, but are not two heads wiser than one? Our chapters on enemies, spraying, harvesting, grading, packing, processing and marketing, are particularly complete. Where words will not tell the story clearly enough, pictures and drawings are used. For instance, with it as a guide, you can identify any bug or fungus; diagnose any fruit tree disease; prune any kind of a fruit tree in the proper manner; you can put smoothly-peeled peaches, whole or halved, into the small glass jars you see in the city groceries, and you can do a hundred other things you will be called upon to do on a fruit farm, which will pay you the extra money.

$2 VALUE FOR $1

Send us $1 NOW, and we will send you **The Fruit-Grower** one year, and **The Fruit-Grower's Guide-Book.** The subscription price of **The Fruit-Grower** is $1 per year, and the price of the book is $1—you are getting $2 value, considering the regular price. In reality you are getting a $500 value, for the magazine and the book will be worth that much to you if you have not had them before. Properly read, they amount to a thorough education in fruit culture. How much would that be worth to you? Send your order in at once, as this offer will not hold indefinitely, and you may be missing some good chances right now, which the magazine or the book will tell you of.



THE FRUIT-GROWER

ST. JOSEPH **MISSOURI**

Choose the Pioneer!

The average sprayer has been on the market only a few years—five or ten is about the limit for a good many of them.

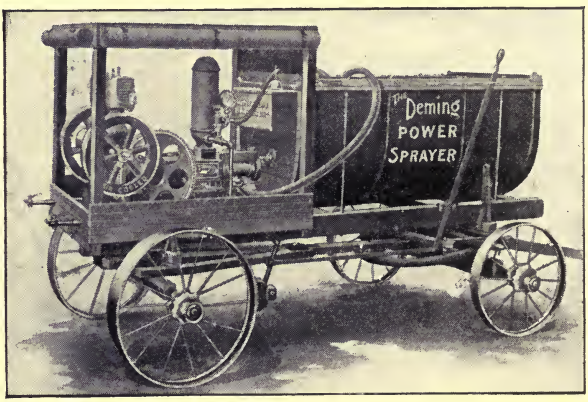
We commenced making Deming Sprayers in the early 90's; we have been in the spray pump business for nearly *twenty years.*

That gives us a big start—we've kept right at it, every year up to and including this present one, trying out our own machines. We've watched them at work in our customers' orchards—tried them under every kind of severe test to find out where they needed improving—and have brought the original types of 1891 to the compact, well-balanced, enduring machines with which the growers of the country are so familiar.

We make several styles of power outfits, and more than 15 different hand machines beside. Our nozzles are known everywhere, as well as our attachments, hose and other supplies.

MORE ON NEXT PAGE—READ ON

THE DEMING "PREMIER." 2½ or 3½ H. P. Engine, Air-cooled



Deming Spray Pumps

Used By Successful Orchardists Everywhere

A great many of whom, when buying additional equipment, *specify "Deming's" again*. That, we think, is the strongest O. K. they could give. Deming's Spray Pumps please the growers for several good reasons:

They are *designed* right—well-balanced. Their construction is substantial, rigid—all parts in constant alignment. No surplus weight—a big feature in *any* orchard, particularly one on a hillside.

They are *built* right. All parts touched by spray liquid are solid brass—can't corrode. Other castings are made of durable, close-grained gray iron, carefully inspected before assembling.

They *work* right—maintaining a strong, steady pressure, varying from 80 to 250 pounds, according to the number of nozzles. The spray is driven hard and in a fine, misty fog against the branch—and it *sticks* there, doing the most lasting good.

Deming Outfits are handled by leading hardware dealers; stocks carried in principal cities. Catalogue free—we'll include a copy of Prof. Weed's valuable little book, "Spraying for Profit," if you mention having seen this advertisement in "How to Grow and Market Fruit." State how many trees or acres of orchard you have.

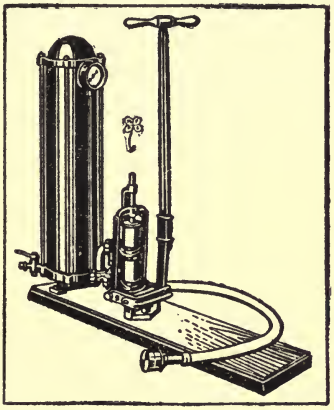
THE DEMING COMPANY

105 SUCCESS BUILDING **SALEM, OHIO**

Manufacturers of Hand and Power Pumps for All Uses
Compression Tank Systems, Hydraulic Rams, Etc.

THE DEMING "CENTURY"

THE DEMING "SAMSON"



Deming Spray Pumps

Use Orchard Brand Sprays For EFFECTIVE Control

Lime-sulphur Solution

—

Soluble Oil

—

Arsenate of Lead

—

Atomic Sulphur

(The greatest known fungicide)

COÖPERATION Means Mutual Benefits

Our customers receive, free of charge, or of obligation, the most valuable orchard information and help.

—

Write for Orchard Census Blanks—they are free

Oriole Weed Killer

Kills grass and weeds anywhere

—

Atomic Sulphur and Arsenite of Zinc

For potatoes and truck

You wouldn't spray your trees with clear water, just for the sake of spraying. You'd know it was time and money wasted.

You spray to control "bugs," and you can't afford to waste time and opportunity with spray mixtures that produce uncertain results—when you can get Orchard Brand Mixtures. These solutions always do the work they are intended to do, because the chemicals are combined right and then tested, by makers who have developed great skill through long study of orchard problems.

Shrewd, successful growers all over the United States are using and recommending Orchard Brand Mixtures, because they make results so much more certain, efficiency so much greater, and final cost in relation to returns so much less than any other spraying mixture you could use.

There are wide differences among the varieties of fruit in their behavior in orchards, their resistance to insects and fungi, and in effects of chemical treatment on them. The most successful orchardists are those who understand these differences and apply their knowledge when spraying, pruning and cultivating.

In the development of its business of making insecticides and fungicides, the Thomsen Chemical Company has worked along scientific lines for the past eight or ten years, carefully accumulating knowledge of these differences and of their bearing on orchard operations.

This store of information is at the service of fruit growers. On request, we will furnish blanks for a census of your orchard, on which you can fill in the varieties, age of trees, soil conditions and other data. This will enable us to give you many valuable hints that will mean dollars in your pocket.

Write for some blanks and for information about Orchard Brand Spraying Mixtures now. The time to plan next year's spraying is months before you start. You don't know what handy, efficient spraying is till you get acquainted with us—let us hear from you.

THOMSEN CHEMICAL COMPANY

Atomic Division, BALTIMORE, MD.

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